GENERAL LIBRARY
JUL 1 0 1919

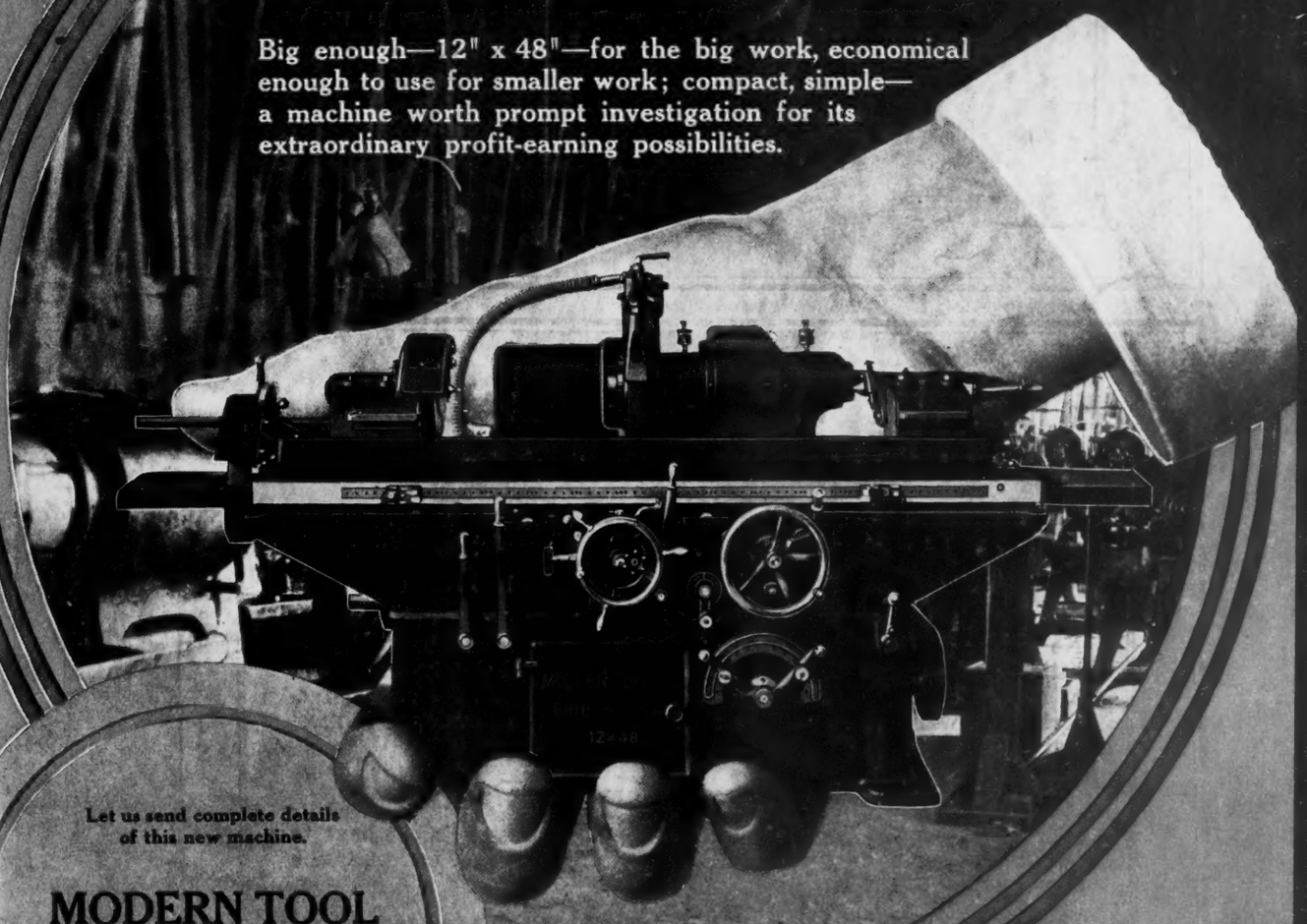
Volume 25 APRIL 1919 Number 8

MACHINERY

THE INDUSTRIAL PRESS, Publishers, 140-148 LAFAYETTE ST., NEW YORK

Room in Everybody's Shop for the
Newest Modern Grinder

Big enough—12" x 48"—for the big work, economical enough to use for smaller work; compact, simple—a machine worth prompt investigation for its extraordinary profit-earning possibilities.

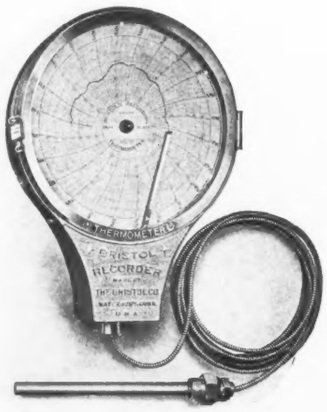


Let us send complete details of this new machine.

MODERN TOOL COMPANY
MAIN OFFICE AND WORKS:
ERIE, PA., U.S.A.

Buy Victory Bonds

SEE LAST PAGES FOR ADVERTISERS' AND PRODUCT INDEXES



No Expert Attention Required

to install or keep in perfect working condition

TRADE MARK
BRISTOL'S
REG. U.S. PAT. OFFICE

Recording Instruments

THE design is so simple that no experience is necessary to mount and connect any Bristol's Instrument ready for use.

Keeping the pen filled and renewing the charts every day is practically all the attention they require to keep them in continuous service.

That's why so many Bristol's Instruments are now in service for years without repairs.

Their application for recording variations in pressure, temperature, water levels, speed, time, electricity and motion covers the widest range.

Write for Bulletin 204-E

THE BRISTOL CO., Waterbury, Conn.

Branch Offices: **Boston, New York, Pittsburgh, Chicago, San Francisco**

On Their Way to Linde Users

LINDE CYLINDERS—en route to Linde customers—are going forward —on schedule time—tens of thousands per day—

BY AUTO TRUCKS, EXPRESS CARS, FREIGHT TRANSPORTATION, AND SHIPS.

No matter what the varying and fluctuating requirements of big and little users may be—they are now, one and all, absolutely taken care of by Linde Service—a service backed by 64 great interlocking factories and warehouses and the enormous facilities developed to meet war-time needs.

Linde Service Insures Profits

This is the sort of Service that every user of Oxygen must have to *insure* the economies and profits of any important application of the Oxy-Acetylene process.

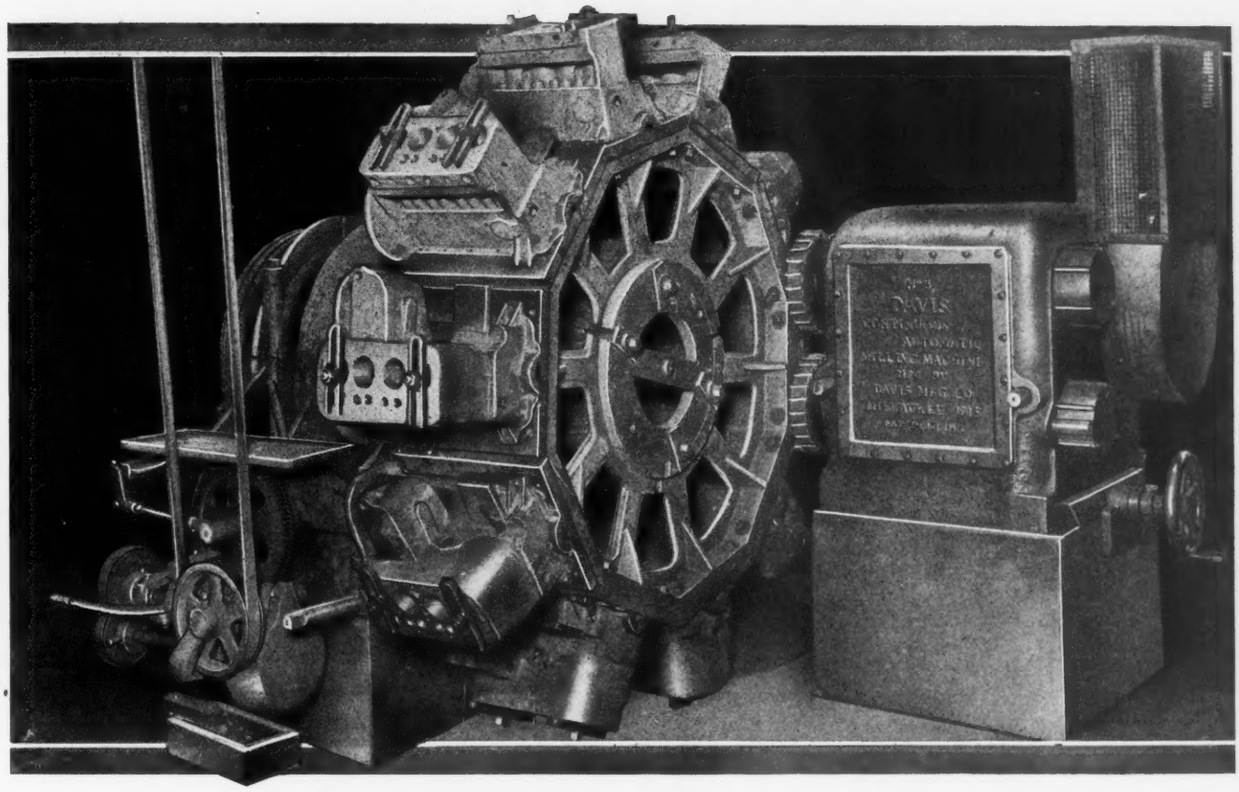
That it is a worth-while insurance is clearly shown by the substantial increase in the number of Linde customers in every district we serve.

The Linde Air Products Company

Largest Producer of Oxygen in the World

30 East 42d Street, New York **Kohl Building, San Francisco**

308-A



Continuous Rotary Milling

First of Two Articles Describing Various Types of Milling Machines that Operate without Interruption, Work-holding Fixtures, and Methods of Setting Up Parts to be Milled

BY EDWARD K. HAMMOND

IN shops where there are a large number of duplicate parts on which one or more surfaces have to be milled, very satisfactory rates of production can often be obtained through the use of so-called "continuous" rotary milling fixtures. This name was decided upon because the work-holding fixture is so designed that it rotates continuously to provide for feeding successive pieces of work under the milling cutters on the machine. The fixture is constructed in such a way that provision is made for holding a number of pieces, and it is carried on a revolving table. Owing to the fact that the operator may be kept constantly employed in removing finished pieces of work and substituting fresh blanks, a very high rate of production may be obtained by this method. Production may also be greatly increased in many cases, by employing two or more cutters for straddle-milling. Furthermore, it is often possible to use a two-spindle machine to good advantage for milling opposite ends of the work. The increased production that has been effected in many cases by substituting continuous rotary milling for some other method is due to reducing the non-productive time of the machine by avoiding the necessity of stopping to set up work and then restarting the machine, by avoiding the need of returning the table to the starting point after each traverse, and by overcoming the necessity of having the machine idle while the operator is setting up work, or the operator idle while the machine is running.

A fairly exact idea of the production which is attained will be gathered from the figures which are cited in connection with the different jobs illustrated. Continuous rotary milling is adapted for handling a considerable range of work, as indicated by the fact that the illustrations show examples of pieces ranging in size from crankcases for automobile engines, down to small iron armature cores. As a general proposition, the best results are obtained with continuous rotary milling where the pieces to be machined are of rather small size, so that a considerable number of parts may be mounted in the fixture at one time. For machining such work as automobile crankcases, it is probable that just as satisfactory a rate of production would be obtained by handling the work on a planer-type milling machine, on which a number of castings could be set up and all of them milled at a single traverse of the table. For milling small parts such as the armature cores, however, the continuous rotary process offers an ideal method of handling the work.

Importance of Correct Design of Work-holding Fixtures

When the designer is working out the details of continuous rotary milling fixtures, regardless of the special nature of the operation for which they are to be employed, there are certain general principles which should be observed. Among these the following are worthy of particular attention. As the rate of production is usually limited by the operator's ability to remove finished work and substitute fresh castings in the fixture, especial care should be taken to make the action of the clamping devices as simple and rapid as possible. It is also important to see that the design of clamps is such that they will grip the work securely without a tendency to produce distortion. Another important point is to have the pieces of work held as close to each other as possible. The reason for this is that the table rotates at a uniform speed, so that the total non-productive

time for each complete revolution of the fixture is represented by the amount of time which is wasted while the cutters are passing over gaps between adjacent pieces of work. Evidently, it is important to minimize this loss of efficiency by reducing the space between the pieces of work to the absolute minimum. Attention is also called to the fairly obvious fact that the output is not dependent upon the number of pieces which the fixture holds, but upon the rate at which these pieces are fed to the milling cutters. This rate of production is, of course, independent of the diameter of the fixture, and as a general proposition the circle should be made as small as is consistent with the shape and size of the pieces which are to be milled. The reason for this is that the cost of the fixture will be reduced by following this practice. Where there are several parts of the same general design but slightly different sizes, it is often practicable to design a single fixture which will provide for milling two or more pieces of work, thus substantially reducing the incidental expense for special equipment. Unless it cannot be avoided, fixtures should never be designed in a way which will make it impossible for the operator to remove milled pieces and replace fresh blanks as rapidly as the table of the machine revolves. Two or more operators can often be advantageously employed to load and unload the fixtures, thus allowing the feed and rate of production obtained to be substantially increased.

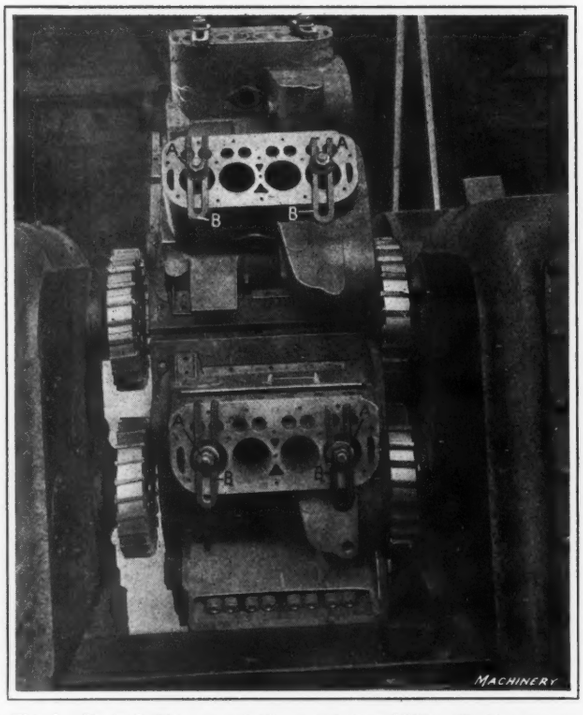


Fig. 1. Davis & Thompson Continuous Rotary Milling Machine set up for milling Opposite Ends of Cylinder Blocks for Avery Tractor Engines

While designing a fixture which is to be used for clamping work of any given form on the rotary table of a continuous milling machine, and estimating the rate of production which can be obtained in handling the job, careful attention must be given to the design of the mechanism by which pieces are clamped in the fixture, and to the probable length of time which will be required for securing each piece in position ready to be milled. When attention is not given to these points, it will frequently happen that the time required to set up work is greater than the time actually required for performing the machining operation, and as a result rates of production will be retarded through the inability of the operator to substitute fresh blanks for milled pieces as fast as they are turned out on the machine. This condition will also make the production estimates erroneous, because in such cases the designer of the fixture may select a rate of speed and feed for operating the machine which will prove quite satisfactory in practice, but his calculation of rates of production based on these rates of speed and feed will prove incorrect because attention has not been given to the length of time consumed in setting up blanks and removing finished pieces from the fixture. It will, of course, be understood that such a complication only arises in those cases where the time taken in setting up the work is greater than the time required for the milling operation.

In a considerable part of the following description of applications of the continuous rotary milling principle for the performance of machining operations required in manufacturing duplicate parts, the discussion of this subject will be chiefly concerned with the application of milling machines of standard design equipped with rotary fixtures to provide for the performance of milling operations on pieces of small or medium size. Owing to the limited capacity of knee-type milling machines, it would be impracticable to attempt to construct rotary fixtures for holding a number of large sized pieces of work, and on that account an attempt to employ such equipment for the continuous rotary milling of large pieces results in the loss of many of the advantageous features of this method. In order to provide for obtaining maximum efficiency in the continuous milling of parts having approximately the size of automobile engine cylinder blocks, crankcases, transmission cases, etc., Davis & Thompson, 803 Security Bldg., Milwaukee, Wis., are now making a new type of machine which is especially adapted for machining pieces of considerable size. These articles are chiefly concerned with a discussion of the design of fixtures, methods of operation, and a statement of the rates of production which are obtained in handling various typical classes of work. It is assumed that readers of MACHINERY are familiar with the general features of design of standard milling machines, and so a detailed treatment of this has not been considered necessary. In the case of the Davis & Thompson machine, however, of which only five have at present been built, a general description will doubtless prove of interest.

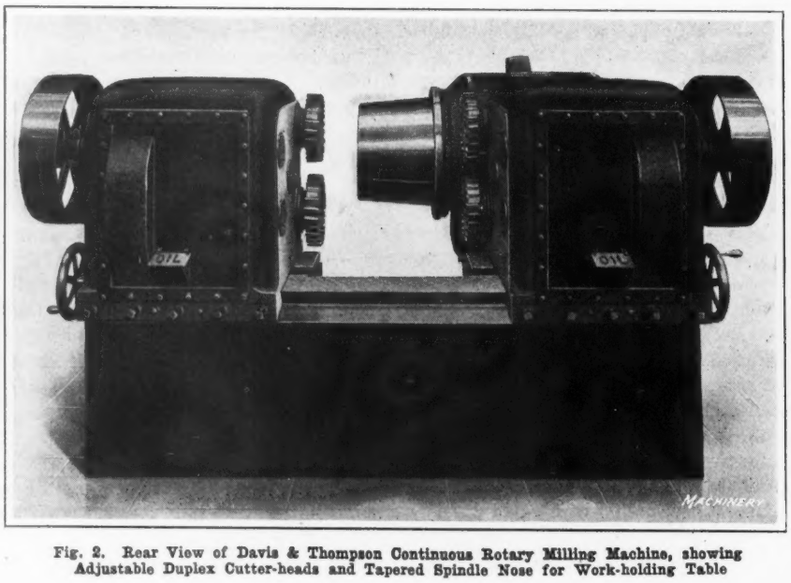


Fig. 2. Rear View of Davis & Thompson Continuous Rotary Milling Machine, showing Adjustable Duplex Cutter-heads and Tapered Spindle Nose for Work-holding Table

Davis & Thompson Continuous Rotary Milling Machine

The Davis & Thompson milling machine has four main parts, namely, a rotating table on which the work is carried, two duplex cutter-heads, and a bed upon which the cutter-

heads and support for the rotary table are carried. Each cutter-head is equipped with two spindles which have independent longitudinal adjustment to provide for locating the cutters on these two spindles in such a position relative to each other that a roughing cut is taken with the first, and a finishing cut with the second cutter. Usually about 0.020 inch is left for the finishing cut. In addition to the adjustment of the spindles in each head, the heads themselves are provided with longitudinal adjustment on the bed of the machine in order to leave the required amount of space between the cutting edges of the tools mounted on these opposed spindles. It will be seen from the illustrations showing the performance of typical machining operations on this type of milling machine, that the cutters carried by the two heads may be used to mill opposite ends of the same piece of work, as in the case of the cylinder blocks shown in Fig. 1; or two rows of castings may be set up on the table to provide for rough- and finish-milling a single face on each casting, an example of such a set-up being shown in Fig. 3 which illustrates the milling of one surface on water connections.

In order to reduce the non-productive time of the machine to a minimum and thus obtain the greatest possible output from a milling machine of this type, provision has been made for feeding the work past the cutters at a suitable rate, and then rapidly traversing the table through the space between adjacent pieces of work. If this were not done, a serious loss of time would result through using the slow feed movement to bring the next piece of work up to the operating position. The mechanism by which this intermittent feed and rapid traverse movement is accomplished is designed along the same general lines which were developed for the index mechanism of the Cleveland automatic screw machine, so that a detailed description need not be given. Alternate engagement of the rapid traverse and of the proper rate of feed is accomplished automatically by means of tripping dogs mounted on a drum which rotates with the table and engages the fast or slow movement according to whether the cutters have just come into engagement with or passed out of contact with the work. Standard sized milling cutters are always used on these machines, which are 12 inches in diameter; and the gear drive between the single pulley on each head and the two spindles is worked out in such a way that the proper cutting speed is obtained for the class of work on which the machine is to be used.

A rotary table is usually designed for each special job that is to be done on the machine, although it is frequently possible to arrange interchangeable work-holding fixtures to adapt the same table for milling several different pieces. Where one of these machines is used for milling a number of different pieces of work, it will often be found economical to have a separate table with suitable fixtures for holding each class of work, provided the different pieces of work are milled with sufficient regularity to pay a satisfactory return on the tool investment. It will be seen from Fig. 2 that a tapered nose is provided on the spindle which carries the rotary table. With such a construction, it becomes an easy matter to bore the different tables to the required fit, and then their accurate location on the machine is easily and rapidly accomplished. Less time is consumed in changing tables in this way than would be necessary to set up a whole new set of work-holding fixtures on the table. So far as the features of milling operations performed on these machines are concerned, they are in every way comparable to those discussed in connection with the application of continuous rotary milling on knee-type machines, so that in order to give a comprehensive idea of results obtained through use of the Davis & Thompson millers, it is merely necessary to describe one or two typical jobs, and the rates of production which are obtained. These machines are especially adapted for handling heavy work, and in order that the high-speed steel inserted-tooth milling cutters which are used may be run at a rate of speed and feed approaching their maximum capacity, all members of the mechanism have been liberally proportioned to withstand severe stresses. On account of the rapidity with which the work may be fed to the cutters, it will frequently be found desirable to employ two or more men to remove milled pieces from the fixtures and to set up fresh blanks in their places. If this measure is not adopted, the setting-up time is so much longer than the actual milling time, that it is necessary to slow down the machine in order to enable the operator to perform his part of the work.

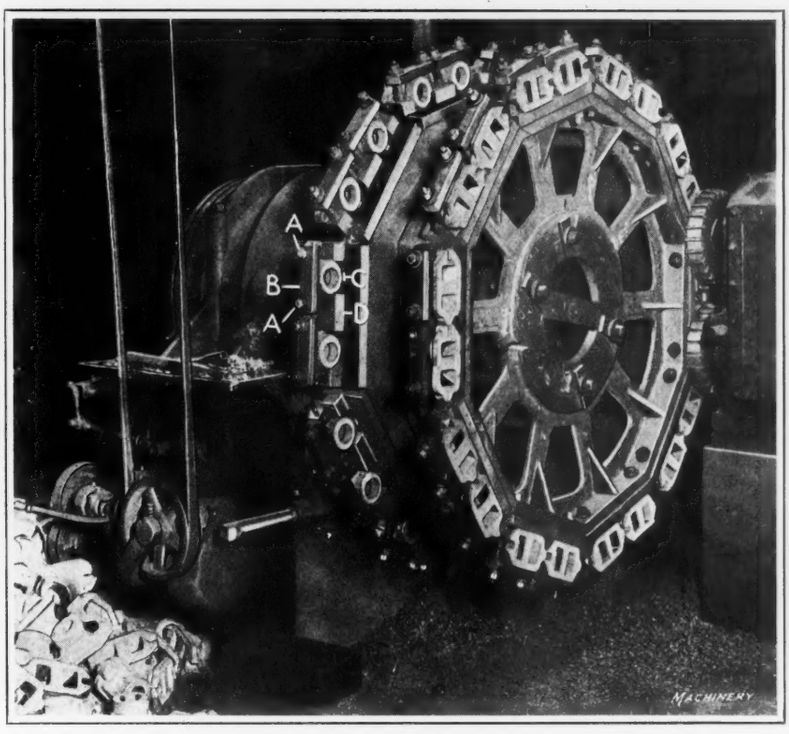


Fig. 3. Milling Water Connections for Avery Tractor Engines. The Same Operation is performed on Pieces at Both Sides of Table

The heading illustration and Fig. 1 show one of the Davis continuous automatic milling machines in use at the plant of the Avery Co., Milwaukee, Wis., where it is employed for simultaneously milling the opposite ends of tractor engine cylinder blocks. In this case, ten castings are mounted on the table, and the cutters, carried by spindles in the opposed heads of the machine, perform rough- and finish-milling operations at both ends of the same piece of work. The fixtures, or more properly faces of the table on which the work is carried, are of extremely simple design. Dowel-pin holes have been drilled in the lower face of the cylinder blocks, and pins provided on each station of the table enter these dowel holes and locate the work ready for milling. It will be seen that there are two bolts *A* extending up through the cylinders at opposite ends of each block. These provide for holding the work, and the utilization of the U-clamps *B* under the washers on these bolts makes it unnecessary to do more than loosen the nuts in order to remove the milled cylinder blocks as they come around to the loading position. On this operation, the rate of production obtained is 200 cylinder blocks in a ten-hour working day.

In Fig. 3, there is shown a view of the Davis continuous milling machine engaged in facing off the joint on water connections for the Avery motor. In this case, it will be seen that the pieces are of relatively small size, and that there is only one surface to be milled, instead of two surfaces, as in the case of the cylinder blocks shown in Fig. 1. For this operation, extreme accuracy in the location of the work is not absolutely essential, and so the rough outer surface of these malleable iron castings may be safely utilized as a locating point. The work is held down in the fixture by means of bolts *A* and clamps *B*, the arrangement of which is clearly shown. Two operators are employed, one at each side of the table, to load castings into the fixtures and to remove milled pieces as they come around again to the loading side. The rate of production in each case is 400 castings per ten-hour day.

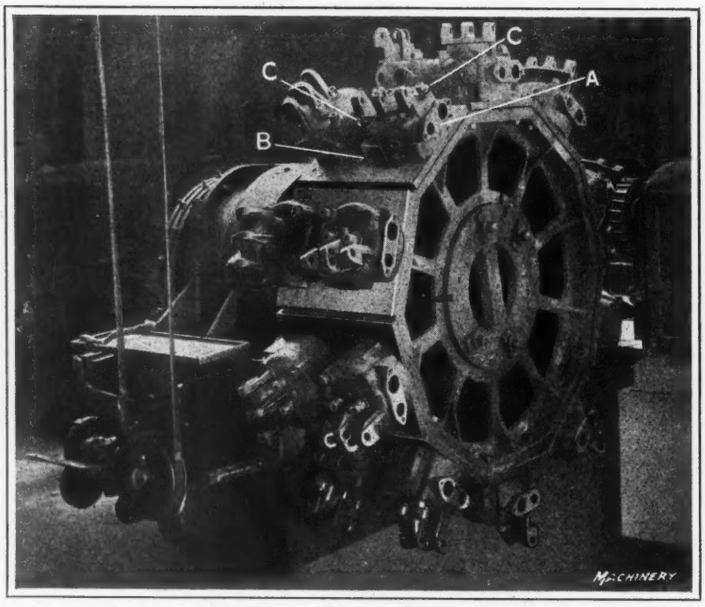


Fig. 4. Face-milling Surfaces A and B of Avery Tractor Engine Cylinder Heads. The Work is reset at the Left-hand Side of the Table to mill Surface B

It will be apparent that to release the work from the fixture it is merely necessary to loosen the nuts carried by the two bolts *A*. Beneath each clamp *B* there are two springs which raise it out of engagement with the work as soon as the bolts are released, and thus enable the milled piece to be withdrawn from the fixture. Mention has been made of the fact that the rough cast surface of the work is used as a locating point. At the front, the work is supported by the lower side of the rectangular shaped face, while at the back there is a small pad *C* upon which the round flange of the water connection is carried; and the side of this flange rests against block *D*. Members *C* and *D* of the fixture form the equivalent of a V-block which supports the thrust developed by the milling cutters and prevents the work from twisting.

Sufficient longitudinal adjustment of the heads on the bed of the Davis & Thompson milling machine is provided, so that even in the case of work of considerable size, on which there is only one face to be milled, it is possible to construct a work-holding table of sufficient width to allow two pieces to be set up side by side in order to utilize both sets of spindles for machining two pieces simultaneously. An arrangement of this kind is illustrated in Fig. 4, which shows a machine for facing off the two surfaces *A* and *B* on the Avery tractor engine cylinder head. It is necessary to have these faces definitely located in relation to each other; and in order to facilitate locating the work for performing the first and second operations, during the course of which these surfaces are milled, use is made of dowel-pins on the fixture, which enter holes drilled in the under side of the head. After obtaining the desired location, the work is clamped by means of two bolts *C* which extend up through holes in the top of the head. It will be apparent that the first operation to mill face *A* is performed with the casting at the right-hand side of the table; and then the work is set up at the left-hand side of the table for performing the second operation to mill face *B*. One man is employed to load and unload castings at each side of the table; and operating the machine in this way, the rate of production attained is 150 cylinder heads per ten-hour working day.

Continuous Rotary Fixtures Used on "Milwaukee" Milling Machines

Both the horizontal- and vertical-spindle milling machines built by the Kearney & Trecker Co., Milwaukee, Wis., may be equipped with rotary tables and suitably designed work-holding fixtures for use in the performance of continuous rotary milling operations. The selection of either the vertical- or horizontal-spindle machine will be governed chiefly by the nature of the work to be handled, but as a general

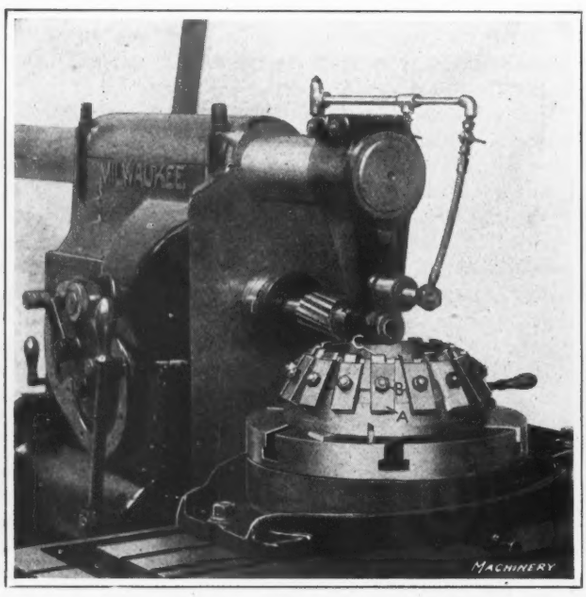


Fig. 5. Kearney & Trecker "Milwaukee" Horizontal-spindle Milling Machine equipped with Rotary Fixture for Continuous Milling of Inserted-tooth Cutter Blades

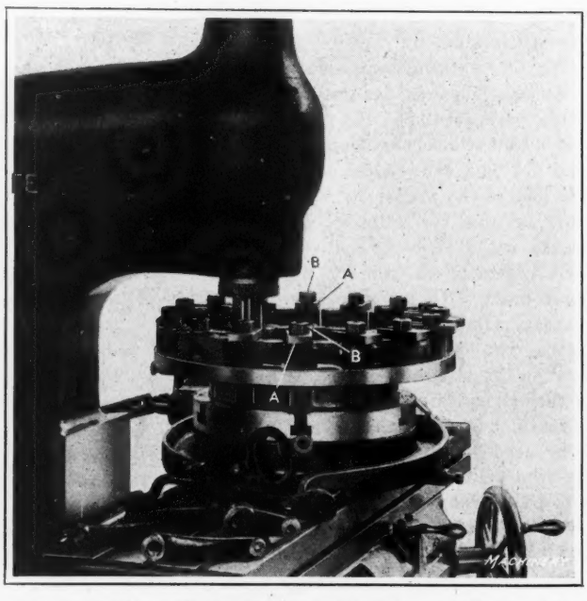


Fig. 6. Continuous Rotary Fixture used in Kearney & Trecker Co.'s Factory, with Provision for holding Different Pieces of the Same General Form

proposition, it will be found that vertical-spindle milling machines lend themselves better to the peculiarities of continuous rotary milling. The reason for this will be apparent after looking over the way in which the machines are set up for performing those milling operations which are discussed in detail in the following paragraphs. Here it will be seen that where provision must be made for milling the upper and lower surfaces of work carried by a rotary fixture, or for the performance of similar operations, a gang of cutters can often be mounted to better advantage on the arbor of a vertical machine than on a horizontal machine. The features of "Milwaukee" milling machines, and of the rotary tables for use in connection with them, are a matter of general knowledge, so that the following discussion will be concerned chiefly with the design of special work-holding fixtures which were designed to carry the different pieces of work that have been selected for discussion in this article, and of the rates of production and other conditions of operation which obtain in handling each of these jobs.

In Fig. 5 is shown the way in which a continuous rotary milling fixture is employed on a horizontal-spindle "Milwaukee" milling machine for use in machining a 45-degree clearance angle on inserted-tooth milling cutter blades. This is quite a simple operation, and only requires the utilization of one plain milling cutter. The fixture is also of extremely simple design, consisting merely of a ring in which sockets are machined to receive the work and hold it at the proper angle so that the clearance surface behind the cutting edge of the blades will be milled to the required angle of 45 degrees. It will be apparent that each piece of work *C* is held in the fixture by means of a strap or clamp *A* which is tightened by a single bolt *B*. As each piece of work comes around to the loading station, the operator only has to loosen the bolt, lift the finished piece of work out of the fixture, and substitute a blank in its place, after which the clamping bolt is again tightened. One operator can easily unload and load a fixture of this kind, and produce 2500 of these high-speed steel blades per ten-hour day.

Where there are a number of different parts of somewhat similar design to be milled, it is often possible to effect a substantial saving in the necessary investment in fixtures and other special tools by working out the design in such a way that provision may be made for milling a number of different parts in a single fixture. An example of this class of fixture design is illustrated in Fig. 6 where it will be seen that in addition to the work held in the fixture, there are seven other pieces of somewhat the same general form lying on the milling machine table. This work-holding fixture has been made in such a way that it is possible to mill all these different pieces by simply changing the positions of the bolts and clamps which secure the work in place. The necessary holes are drilled and tapped so that changes of clamps to provide for milling any of the eight different pieces for which the fixture is adapted may be easily and rapidly accomplished.

The pieces which are shown set up in the fixture are connecting link levers for the knee mechanism of "Milwaukee" milling machines. In performing this operation, it is found desirable to employ two operators, one of whom loosens the clamps and removes the milled pieces from the fixture, while the other substitutes fresh blanks and clamps them in place, ready for milling. U-clamps *A* are used for holding the work, these clamps being so designed that it is only necessary for the operator to loosen nut *B* to withdraw the clamp. After this has been done, the hole in the work is of sufficient size to enable it to be lifted over the nut. Obviously, a great deal of time is saved by avoiding the necessity of screwing the nut all the way off the bolt. It will be apparent from the illustration that the operation in this case consists of spot-milling the round face on an arm on the work. This face is 2 inches in diameter and the depth of cut averages ⅛ inch. The material is malleable iron, and two operators engaged in loading and unloading the fixture on this machine are able to turn out 10,000 pieces in a ten-hour working day.

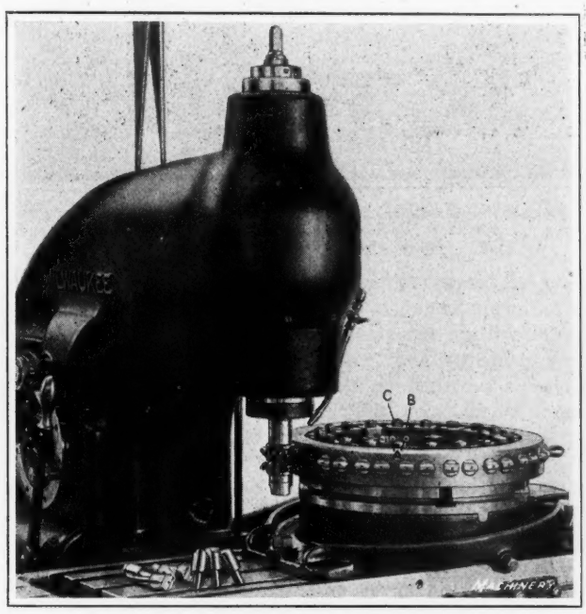


Fig. 7. Kearney & Trecker Continuous Rotary Fixture designed to perform Two Successive Operations. This Illustration shows the First Milling Operation

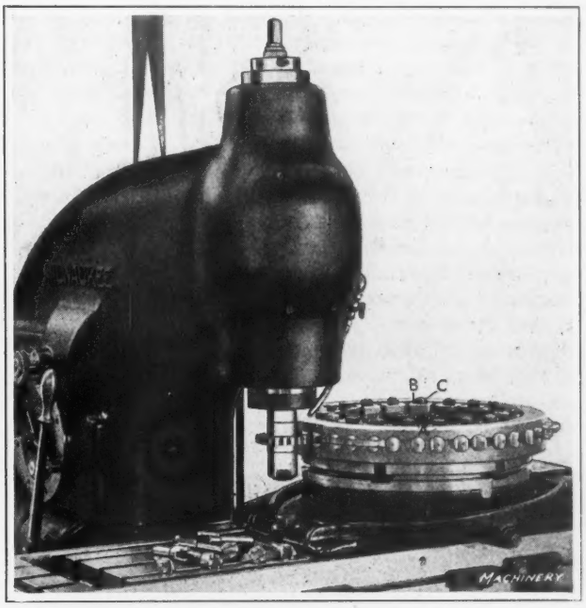


Fig. 8. Pieces milled as shown in Fig. 7 are reset in the Same Fixture at an Angle of 90 Degrees from Original Position, Ready for performing the Second Operation

In addition to designing work-holding fixtures to provide for the performance of milling operations on a number of different parts, it is often possible to use the same fixture for performing two or more operations on the same part, thereby effecting an economy in expenditure for tools. Where this practice is adopted, it will usually be found most satisfactory to perform the milling operation on several thousand pieces of work; and after these have been milled, it is merely necessary to change the cutters on the arbor of the machine for performing the second operation, and to make subsequent changes for any additional operations which are needed to complete the work. An example of the way in which a single work-holding fixture may be utilized for the performance of two successive milling operations is illustrated in Figs. 7 and 8. Reference to these illustrations will show that the first operation on the work consists of milling the head to a semi-cylindrical form, as shown in Fig. 7; and after this has been done on all of the pieces, the work is turned through an angle of 90 degrees and set up in the

position shown in Fig. 8, ready to have a slot milled transversely across the head.

It will be obvious that the first operation is performed with a formed milling cutter, and that a narrow side milling cutter is used for the second operation. The best idea of the way in which the work is clamped will be obtained by looking at the ends of the pieces that can be seen at *A* projecting inside the ring body of the fixture. Here it will be apparent that a strap *B* actuated by a single clamping bolt *C* engages the inner ends of two pieces of work so that both are secured in place by one bolt. After the milling operation has been performed, it is merely necessary to loosen this bolt about one-half turn and then draw the pieces of work out, and push other blanks into the holes which have been made vacant to receive them. For performing the first operation on these parts, the rate of production is 2000 pieces in a ten-hour working day, while the second operation may be run at a higher rate of feed, making it possible to produce 3000 pieces per day. These parts are roller plungers for the feed trip on "Milwaukee" milling machines, and they are made of steel. One operator is able to load and unload the fixture.

Continuous rotary milling is especially adapted for use in machining pieces of moderately small size, but it frequently happens that there are opportunities for performing face-milling operations on machines equipped with rotary fixtures. Fig. 9 shows a vertical-spindle "Milwaukee" milling machine used at the plant of the Madison-Kipp Lubricator Co., Madison, Wis., for use in machining the bases of pump bodies. The pieces to be milled have two holes drilled in them, which are utilized as locating points by slipping the work over pilot *A* and pin *B*. At each station there is also a supporting bracket *C*, which is pivoted so that it may be swung around behind the casting and then pushed inward by means of an eccentric at the end of lever *D*. It will be seen that there is a hole *E* in the bracket which receives the outer end of pilot *A*, thus assisting to steady the work and eliminating vibration. In milling these faces, the average depth of cut is approximately ⅛ inch, and the size of surface to be milled is 2 by 3 inches. With one operator

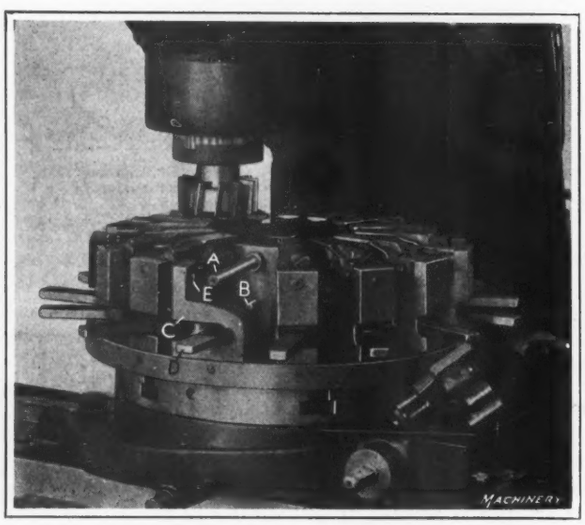


Fig. 9. Face-milling Plunger Pump Bases on Continuous Rotary Milling Machine at the Madison-Kipp Lubricator Co.'s Plant

engaged on the machine, these gray iron castings can be milled with this equipment at the rate of 800 per ten-hour working day.

Continuous Rotary Milling on Becker Machines

Vertical-spindle milling machines built by the Becker Milling Machine Co., Hyde Park, Mass., are used in many plants in connection with rotary tables for applying the continuous principle for the performance of milling operations. Where there are pieces of work which have to be milled at both ends, an important feature of the equipments designed and built by this company is that an auxiliary vertical spindle may be provided on the machines, so that it is unnecessary to reset the work for a second operation on the opposite end from that previously milled. Regardless of the amount of care which is taken in designing the clamping mechanism on work-holding fixtures, it often happens that the setting-up time is longer than the milling time, and, as a result of this condition, it will be obvious that the possibility of eliminating a second setting of the work is likely to be the

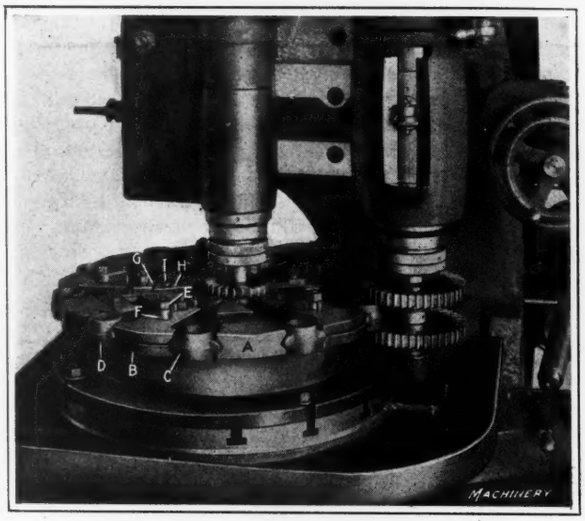


Fig. 10. Becker Continuous Rotary Milling Machine equipped with Auxiliary Spindle for straddle-milling Both Ends of Connecting-rod Forgings simultaneously

means of greatly reducing production costs. In several of the following examples of the tooling up of Becker vertical-spindle milling machines for operation on the continuous rotary principle, it will be seen that a gang of two or more cutters is mounted on the spindle to provide for milling several surfaces on the work simultaneously. Where an auxiliary spindle is provided on the machine, the application of a gang of cutters on each of the two spindles provides a method of milling many classes of work by which the cost of the production is doubtless kept quite close to an absolute minimum.

A little thought given to the question of fixture design will often be the means of greatly increasing the rate of production attained in performing the milling operation. For instance, consider the case shown in Fig. 10, where a machine is illustrated set up for milling the faces of bearings at both ends of automobile engine connecting-rods. For handling this job, the designer adopted the use of an auxiliary spindle on the machine so that both ends of the connecting-rods could be milled simultaneously. Then he went a step farther by setting up two milling cutters on each spindle, in order to make provision for milling both sides of the connecting-rods at the same time. The arbors are piloted at their lower ends to maintain accurate alignment and perfect rigidity. An interesting condition was brought to light after this fixture was placed in service, and the experience thus gained caused the designer to make a slight change in working out the details of the fixture used for machining Liberty motor connecting-rods, shown in Fig. 11, for the machining of which the Becker Milling Machine Co. was called upon to build machines and design work-holding fixtures.

Designing Fixtures to Reduce the Load on Clamps

In the case of the fixture shown set up on the machine in Fig. 10, it will be seen that each connecting-rod is placed in a radial position and the rotary table on the machine is arranged to run in a clockwise direction. Provision is made for carrying ten forgings in the fixture. The only criticism of this lay-out is that as the connecting-rod forgings are fed under the cutters, the milling operation on one end of

a piece of work is completed before the opposite end is fed up to the cutters. As a result, the cutters exert a thrust on the work first in one direction and then in the other, which imposes an unnecessarily severe load on the clamps. Benefiting by this experience, the designer who was later called upon to lay out the work-holding fixture for machining Liberty motor connecting-rods, designed the equipment as shown in Fig. 11 so that the pieces of work are located tangentially instead of radially. The result of this arrangement is that

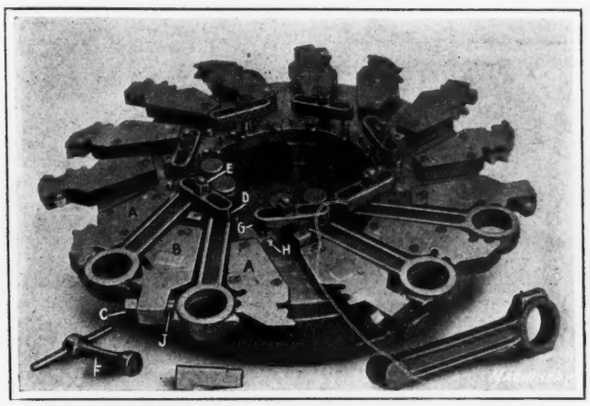


Fig. 11. Fixture for straddle-milling Both Ends of Liberty Motor Connecting-rod Forgings simultaneously. The Work is mounted tangentially so that Opposite Ends of the Same Forging are milled simultaneously to neutralize End Thrust

the two sets of cutters which mill the opposite ends of each connecting-rod, come into simultaneous engagement with the same piece of work, thus neutralizing practically all of the thrust which the different cutters impose on the work in opposite directions, and relieving the clamps on the fixture of a great part of the strain to which they would otherwise be subjected. To secure this neutralization of the thrust on the work, it is necessary to have the milling cutters revolve in opposite directions.

A brief description of the way in which the work-holding clamps on each of these fixtures operate will prove of interest. Referring first to Fig. 10, it will be seen that the large ends of the connecting-rods are held at each side by V-blocks which fit around the bosses provided on the forgings to receive the bearing cap bolts. A solid block *A* is rigidly bolted to the body of the fixture, while block *B* is split horizontally through the middle, forming a fixed lower plate and a removable upper plate. In loading this fixture, two connecting-rods, say *C* and *D*, are put in place or removed at the same time. Provision is made for rapidly raising the upper plate of clamp *B* by simply loosening nut *E* about one turn and then swinging back the pivoted C-washer *F*. When this is done, the plate can be raised sufficiently so that the milled connecting-rods *C* and *D* can be lifted out of the vees and rough forgings substituted in their places. After these forgings have been put into position, the upper plate of clamping member *B* is dropped, thus providing for gripping the boss on each side of the new forgings in the V-blocks, and the work is securely held at this end after C-washer *F* is swung into place under nut *E* and the nut is tightened. Each pair of connecting-rods is held at the opposite end by means of a sliding wedge which is pushed between the small ends of the forgings to force them into contact with the sides of blocks which are rigidly bolted to the fixture. Movement of the wedge point is accomplished by means of an intermediate plate which is best shown at *G* in Fig. 10. This plate is beveled on its inner edge to engage a corresponding beveled face on the outer edge of wedge *H*. Tightening the nut above plate *G* forces the plate downward, and the beveled edge of plate *G* acting against the beveled face of wedge *H* forces the wedge inward between the inner ends of the connecting-rods, thus holding them rigidly in place against the sides of the fixed blocks. Attention is called to the fact that each of the wedges *H* is held onto the body of the fixture by a screw *I*, which fits into an elongated hole. It will be seen that this arrangement provides for holding the wedge in place and at the same time allows it the necessary lateral movement.

How Quick-acting Fixtures Increase Production

On the fixture shown in Fig. 11 on which the Liberty motor connecting-rods are mounted in a tangential position, two forgings are set up at one time, as in the preceding fixture. It will be seen that fourteen forgings are carried by the fixture, and the pieces are milled on four surfaces. The machine is operated with a feed of 4 inches per minute and forty forgings are machined per hour. It will, of course, be obvious that the work is done on a two-spindle machine, with two cutters on each arbor to provide for milling all four surfaces on the work simultaneously. In this case, each pair of connecting-rod forgings is held between two clamp members *A*, which are rigidly bolted to the fixture, and a pivoted clamp member *B*. It will be apparent from the illustration that these clamps are made with vees to receive the bosses on the forgings in which the bearing cap bolt holes are to be drilled. When two forgings have been dropped into place in the fixture, bolt *C* is tightened, pushing the connecting-rod forging in front of clamp *B* up firmly into contact with clamp *A*. At the same time, clamp *B* swings back on its pivot to provide for securely clamping the connecting-rod forging behind this clamp against the second clamp *A*. At the inner end the forgings are secured by a strap *D*, held down by nut *E*, which is tightened by a T-wrench *F*. Provision is made for eliminating the possibility of straps *D* being set in a position where they will interfere with the milling cutters. It will be apparent from the preceding description that two forgings are held in place in this fixture by simply tightening bolts *C* and *E*, so that the operation of setting up the work is extremely rapid. Attention is called to the small block *G* and pin *H* which are provided at each station on the fixture. These fit into the channel in the connecting-rod forging; block *G* constitutes an end stop for locating the work, while pin *H* affords a support for the forging to prevent it from being sprung by the pressure of the cutter. A better idea of the construction of clamping bolts *C* will be obtained by referring to Fig. 12. Here it will be seen that the bolts *C* are threaded into the tapped holes in V-blocks *J*, which slide in holes machined in the pivoted clamps *B*, to come into engagement with the large ends of the connecting-rods and secure them in place in the fixture, as described in the foregoing.

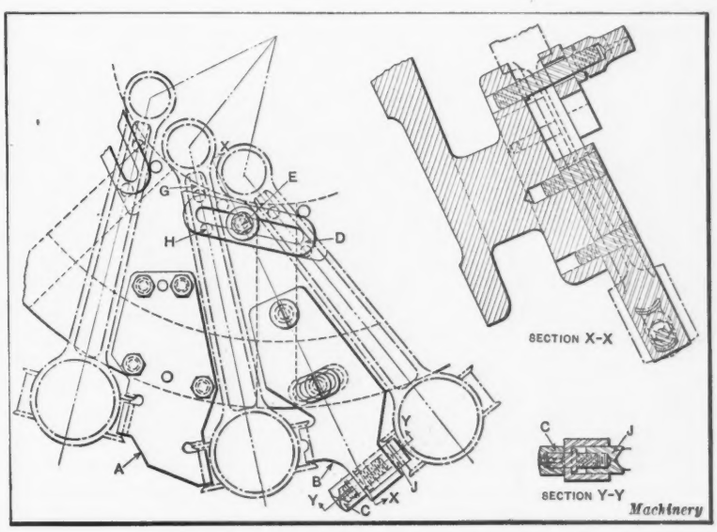


Fig. 12. Details of Work-holding Fixture shown in Fig. 11

Application of Continuous Rotary Milling Principle for Machining Large Pieces

Mention has already been made of the fact that the principle of continuous rotary milling is especially adapted for machining pieces of relatively small size, although the method is by no means confined to the handling of such work. As an example of the way in which larger pieces are machined, the reader's attention is directed to Fig. 13 which shows a fixture designed for use in machining the differential gear housing for a well-known make of automobile. The work is malleable iron, and each casting weighs approximately 40 pounds. It will be apparent from the illustration that in this case only two pieces are set up in the fixture at one time, the method of operation being such that the single large face milling cutter is working on one casting while the operator is removing the other piece which has just been milled and substituting a fresh casting in its place. Each of the two stations on the work-holding fixtures is equipped with two trunnion cradles *A*, so that the work can be dropped into place and held down by means of straps *B* at each end. In this case the table is arranged to rotate in a counterclockwise direction so that the milling cutter first engages the work at the side nearest to the center of the table. In order to prevent the work from rotating, provision is made for supporting each of the castings on the inner side, so that the pressure of the milling cutter cannot cause these castings to rotate on their points of support. The rate of production is twenty-two pieces per hour.

Provision for Milling Both Sides of a Cover Plate

In Fig. 14 is illustrated a fixture designed for use in facing both sides of an automobile starter cover on a machine equipped for continuous rotary milling. In working out the design, it was found that ample production could be obtained from one single-spindle machine, and to enable it to be operated continuously without requiring the fixtures to be changed for milling the two sides of the work, the fixture was designed with provision for milling one side of the starter cover while it is held at one station and then transferring this piece of work to an adjacent station on the fixture ready for milling the opposite side. It will be apparent from the illustration that alternate stations are arranged for holding the work for the first and second operations, respectively, and the fixture has a capacity for holding seven pieces of work in each position. For the first operation, the work is set up to mill face *A*, and for this purpose the under side of the rough casting is located against three stops *B* which constitute the equivalent of a vee into which the casting is forced by means of clamping screw *C*. It will be apparent that this screw is pointed both inward and downward, so that tightening it serves the double purpose of forcing the work into the vee formed by the three locating stops, and of holding the work down onto the faces of these stops. After the first operation has been performed, the work is turned over, ready for milling surface *D*. For this purpose the milled surface *A*, which was finished during the preceding operation, constitutes the locating point, and the work is clamped down on a pad on the fixture which engages surface *A*. Stop-pins *E* prevent the work from slipping away from the pressure of the cutter, and the work is held down by means of two straps *F*. The locating spots that hold the work for milling face *D* are at a height above the plugs that support the work while milling face *A*, which is equal to the depth of cut taken at the second operation on face *D*. On this job, the production is sixty pieces per hour, completely milled on both sides.

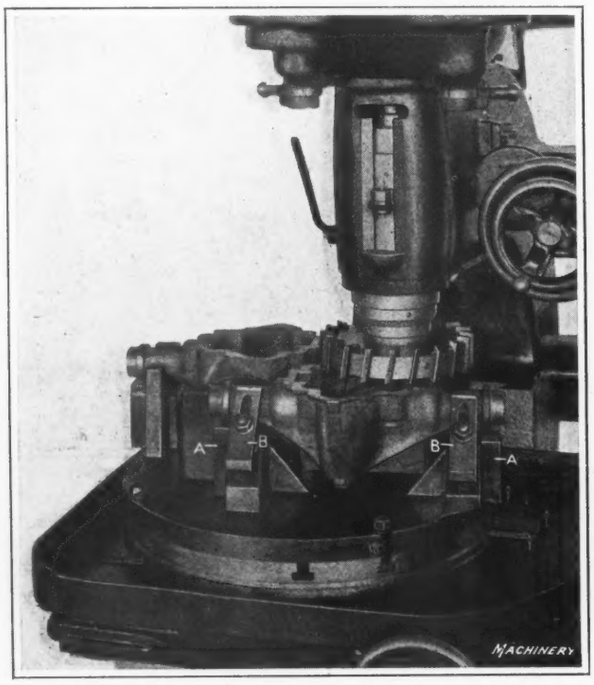


Fig. 13. Milling Differential Gear Housings, showing an Application of the Continuous Rotary Principle for milling Large Castings

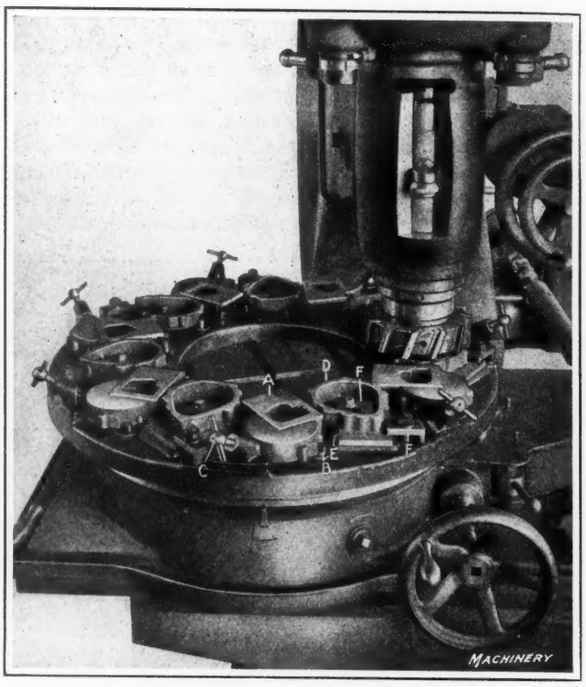


Fig. 14. Fixture for milling Automobile Starter Covers. After milling One Side, the Piece is reset in the Next Station for milling the Opposite Side

The next article on this subject will conclude the description of various types of work-holding fixtures for continuous rotary milling, and methods of setting up the work.

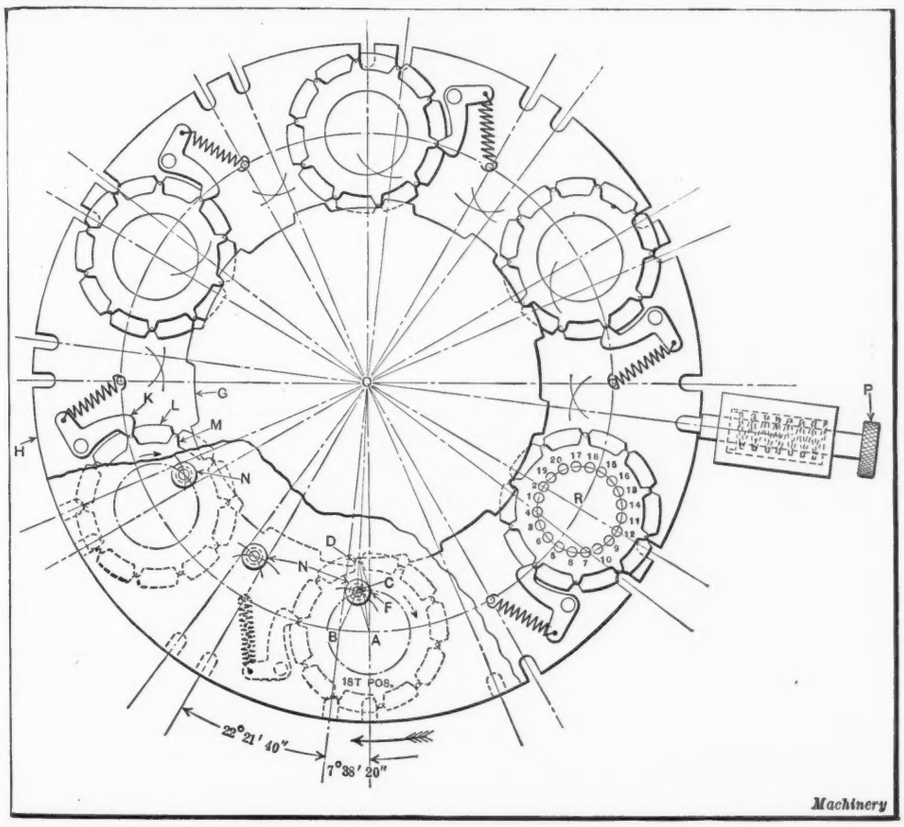
* * *

The American Welding Society has recently been organized through the merging of the welding committee of the Emergency Fleet Corporation and the National Welding Council, formed during the war. All those who are interested are invited to join. The purpose of the organization is to provide a disinterested and dependable source of information on welding. It is proposed to establish a bureau of welding as a separate organization, to unify the welding investigation work of existing societies, which will be made up of a board of directors, one member being appointed by each organization. It is hoped that this movement will give greater stability to welding by standardizing processes. The new society intends to conduct studies, such as the determination of the best current to use with various sizes of electrodes and different types of work in arc welding, and the proper method of procedure in making both gas and electric arc welds, together with an adequate system of inspecting the work. For further information address 33 W. 39th St., New York City.

AN INDEXING DRILL JIG

BY P. W. HIRSCH

The ingeniously devised drill jig shown in the accompanying illustration is the outgrowth of a problem in which it was required to drill twenty ¼-inch holes in a piece, equally spaced on the circumference of a circle 1⅞ inch in diameter. This was to be a production job, 500 pieces being required daily, or a total of 10,000 holes, but it was not considered advisable to go to the expense of ordering or building a special machine for the work. The amount of time required would not permit of doing the job on a single- or even on a double-spindle drilling machine, which would necessitate indexing the piece either twenty or ten times. There was no multiple-spindle machine in the shop large enough to accommodate ten pieces at a time, but a ten-spindle machine was available, which would allow a maximum radius of action of 6 inches. The jig was accordingly designed to be used on this machine, and to contain ten bushings *N* spaced on a stationary plate as shown in the illustration. The rotary plate *H* carries six pieces at a time when the jig is loaded to its full capacity, five of which are being drilled and the sixth loaded. An opening in the bushing plate at *R* allows the pieces to be removed and loaded, as the plate *H* revolves the work to this position. The piece itself has a circular face in which the holes are drilled, and a shank which projects through a hole in plate *H*.



Special Drilling Jig with Revolving Plate for carrying Six Pieces at a Time

After a piece has been loaded and securely fastened to disk *M*, it is indexed to the first position by means of the indexing plunger *P*, and the first hole is drilled. The plate *H* is then revolved 7 degrees 38 minutes 20 seconds by hand, in the direction of the arrow, and indexed for the second hole. During this indexing, one of the teeth on the disk *M* is engaged with a tooth on the stationary plate *D*, and the disk is revolved in the direction of the small arrow, so that the piece is brought into the desired location for the second hole, directly under bushing *N*. This hole is drilled and the disk *H* revolved 22 degrees 21 minutes 40 seconds, and indexed as before. During this indexing, the piece does not revolve, since there is no engagement of the teeth on disk *M* with those on plate *D*; consequently the piece is now in position for drilling the third hole. The next indexing, however, brings the teeth into mesh and revolves the disk *M* as before, so that the piece is in position for drilling the fourth hole, and so on until the piece has made a complete revolution and arrives, completely drilled, at *R*. The holding pawl *K* engages the vees in the aligning disk *L*, which is riveted to disk *M*, and serves to hold the disk in true alignment with bushings *N*.

In designing a jig of this kind, it is first necessary, of course, to determine the exact dimensions for locating the different centers and parts. The following solution of these problems should enable a person familiar with shop mathematics to lay out a jig for performing operations of a similar nature on a piece containing any desired number of holes.

By the conditions of the problem it is known that $OA = 5.5$ inches; $CA = 1.875 \div 2 = 0.9375$ inch; and angle $OAC = 18$ degrees.

Then $OC = \sqrt{CA^2 + OA^2 - 2CA \times OA \times \cos OAC} = \sqrt{0.9375^2 + 5.5^2 - 2 \times 0.9375 \times 5.5 \times \cos 18 \text{ degrees}} = \sqrt{0.8789 + 30.25 - 9.8078} = 4.6174$ inches.

$$\text{Tan } AOC = \frac{CA \sin OAC}{OA - CA \cos OAC} = \frac{0.9375 \sin 18 \text{ degrees}}{4.5625 \cos 18 \text{ degrees}} = 0.06676$$

Angle $AOC = 3$ degrees 49 minutes 10 seconds.

The bushing *N* is stationary; therefore, since the distance from the center of the piece to the circumference on which the holes are drilled must always be the same, $AC = BC$ and $OA = OB$. As *C* is equidistant from *A* and *B*, *OC* is central between *A* and *B*, and *D*, the fulcrum point, must lie somewhere on this center line. The centers of all holes will, at some time during the machining operation, be directly under bushing *N*. Therefore *F* and *C* are equidistant from *D*; but, *F* and *C* are also equidistant from *A*. It follows, therefore, that a line which bisects the angle at *A*, if extended, will contain the fulcrum point *D* which is equidistant from *C* and *F* and which must therefore be at the intersection of this bisector and line *OC*. It is now possible to determine the length *AD*.

Angle $AOD = 3$ degrees 49 minutes 10 seconds

Angle $OAD = 9$ degrees

Angle $ADO = 180$ degrees — (9 degrees + 3 degrees 49 minutes 10 seconds) = 167 degrees 10 minutes 50 seconds

Side $OA = 5.5$ inches

$$AD = \frac{5.5 \sin 3 \text{ degrees } 49 \text{ minutes } 10 \text{ seconds}}{\sin 167 \text{ degrees } 10 \text{ minutes } 50 \text{ seconds}} = 1.651 \text{ inch}$$

When the jig is loaded to its capacity, a fully drilled piece will be produced at every complete revolution of *H*, and since a hole is drilled in five pieces at one time, it requires but four drilling operations to machine twenty holes—that is, the equivalent of the work required for one piece. There is no reverse motion of any kind in any part of the jig, and inaccuracies which might occur from reversing are thus avoided.

SPECIAL TOOL EQUIPMENT FOR SMALL-QUANTITY PRODUCTION

BY JOHN LEAFSTROM

WHEN the product of a manufacturing machine shop is made in a number of sizes and styles, and in small quantities, special tool equipment is usually required which represents a considerable investment. In many cases the outlay in jigs and fixtures, necessary to secure interchangeability and low production cost, may represent a considerable proportion of the machine tool investment. In this class of work one of the disadvantages often experienced is that a large number of the jigs and fixtures remain idle a considerable part of the time. This naturally makes it necessary for a manufacturer whose product is made in limited quantities to make a proportionally larger investment in special tools than the manufacturer whose output requires the continuous use of one or more special tools to produce the number of parts required. An extra burden is entailed both in providing storage space for tools which are used only at intervals, and also in the labor required to set up and take down special tools, which the change in work may demand, with its consequent idle machine time.

Requirements of Special Tools

To manufacture the various parts required with the minimum number of tools is the ideal condition, and this is only

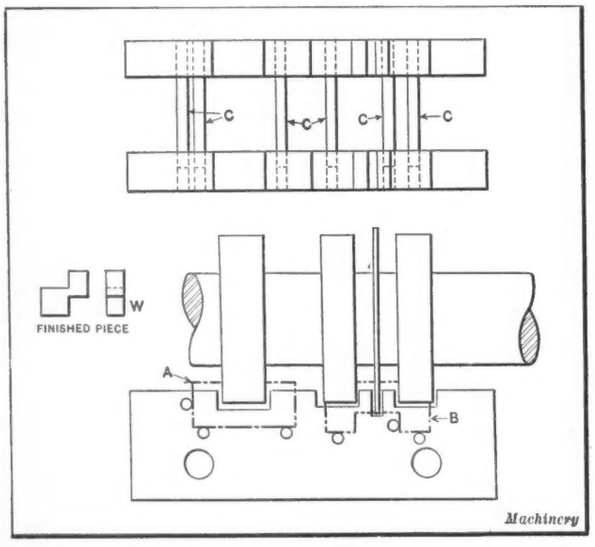


Fig. 1. Vise Jaws designed for performing Two Milling Operations on the Same Piece

possible when the requirements of the work are carefully studied and tools developed that will be suitable for performing the same operation on a number of similar parts or different operations on the same part. The tools described in this article were designed by the writer to suit this class of work, and are illustrated and described as being representative of what can be accomplished in developing different types of tools for machining a number of parts.

Fixture for Two Operations

Fig. 1 illustrates a simple example of a tool designed for performing two operations on the same piece. The piece is made from 5/16- by ¾-inch cold-rolled steel, which is first cut off to twice the length of the finished part plus the thickness of the slitting saw. The blanks are inserted in the left-hand side of the special vise jaws at *A*, and the center cut is then made. After finishing the cut on the blanks which were first loaded, the work is removed and put in the right-hand side of the jaws at *B*, additional blanks being loaded in the left side. At the second cut the steps are milled in the opposite side of the work at *B;* at the same time the parts are separated by the slitting saw and the center cut is also made on the blanks just inserted in the left-hand side of

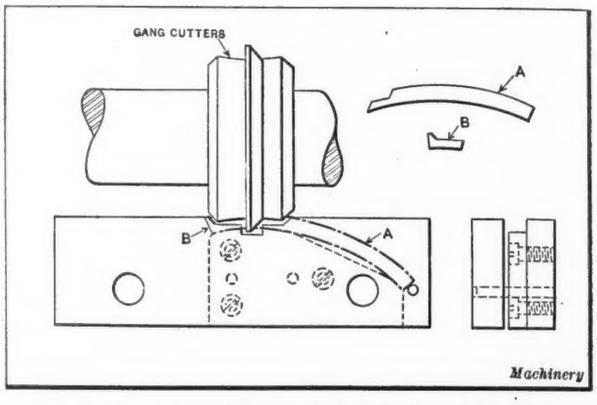


Fig. 2. Vise Jaws and Gang Cutters designed to produce Two Pieces in One Operation

the jaws. The length of the locating pins *C* permit a number of blanks to be milled at one loading.

Two Pieces Produced in One Operation

Fig. 2 illustrates a pair of vise jaws designed for use in producing the two pieces of work *A* and *B* at the same operation. The stock is ¼- by ⅜-inch cold-rolled steel, and the blanks are cut off long enough to make both parts, using the gang cutters shown. At times, due to the difference in the quantities required, it may be necessary to make the part *A* only, in which case the stock is cut long enough for just this one part, the same cutters being used to form the top and to bevel the end.

Universal Drill Jig

Fig. 3 illustrates a universal drill jig used for drilling and reaming the hole in six gear blanks and pulleys similar to those shown at *A*, *B*, and *C*. The work is first ground on both flat surfaces on a surface grinder, after which the hole is drilled and reamed. It will be seen that the work *W* is located from the cored hole by the cone-head plug *F* which fits into the bushing in the base of the jig. The pins *D* projecting from the bottom of the clamps rest against the

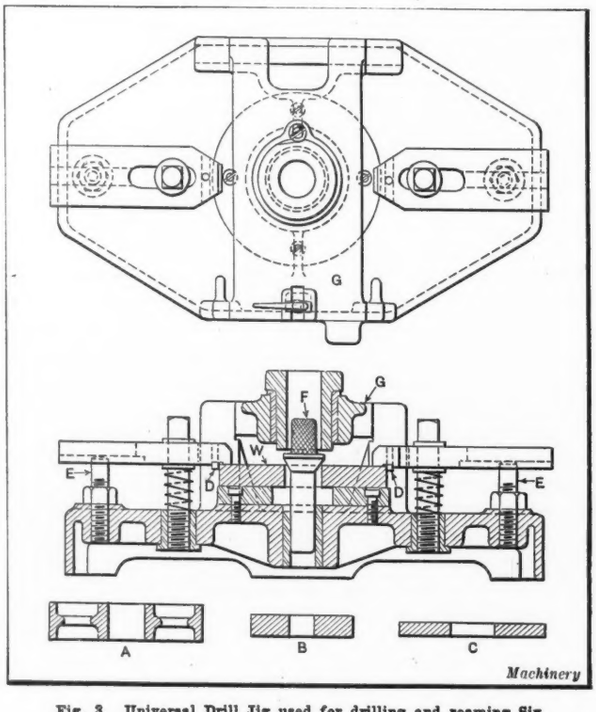


Fig. 3. Universal Drill Jig used for drilling and reaming Six Different Pieces

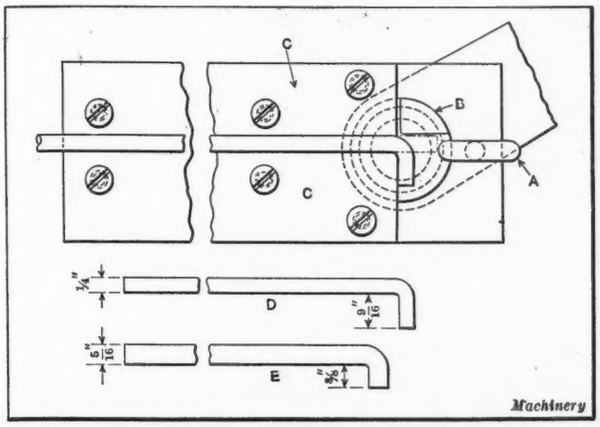


Fig. 4. Bending Fixture developed for bending Cold-rolled Steel Rods

edge of the work, the clamp overlapping the edge of the work ⅜ inch, regardless of the diameter of the blank. The threaded posts *E* are adjusted to suit the thickness of the work. After the work has been clamped, the locating plug *F* is removed, the lid *G* closed and secured, and the work is ready to be drilled. On parts where the length of hole makes it necessary, a pilot reamer is used to insure a straight hole, the bushing in the base of the jig being used as a guide for the pilot of the reamer. The only loose parts required for this jig are the various sizes of slip bushings used. After the work is drilled and reamed, the outside diameter is finished by mounting a number of the blanks on a special arbor and finishing in an engine lathe.

Fixture for Two Bending Operations

The bending fixture shown in Fig. 4 was developed for bending the two cold-rolled steel rods *D* and *E*. It will be seen that the two rods are not the same diameter and that the length of bend also varies. The stock to be bent is inserted in the bending fixture and one end located against the stop *A* to control the length of the bend. As the wiper *B* is brought around to bend the stock, the stop *A* is struck and swung out of the way, as it revolves on a pivoted stem. When the other rod is to be bent the plate *C* is removed and replaced by another plate of different width, forming a groove of the proper size for the different diameter of stock. The stop-pin *A* is lifted out, turned one-half revolution and replaced, presenting the opposite end of the stop-pin head as a stop for the work. As the head of the stop-pin is not symmetrical it will be readily seen that changing the position will produce a different length of bend.

Milling Fixture

Fig. 5 illustrates a milling fixture designed for milling a ¼-inch slot in three sizes of expanding brake rings, like that shown at *G*. By indicating the position of the three sizes of the brakes in the fixture, the method of locating the various sizes is clearly shown. The inside lug of the brake is located on the V-block *A*, and the two pins *B* locate the outside of the smallest brake centrally with reference to the V-block. On the next size of brake the same locating pins *B* are used but the brake locates from the inside instead of from the outside, in order to avoid changing the position of the pins. The largest size brake is located from the outside by means of the pins *C*. The clamp *D* is made long enough to clamp in the proper position. When milling the smallest brake, six pieces are handled at one setting, but when machining the two larger sizes, only four can be handled at once.

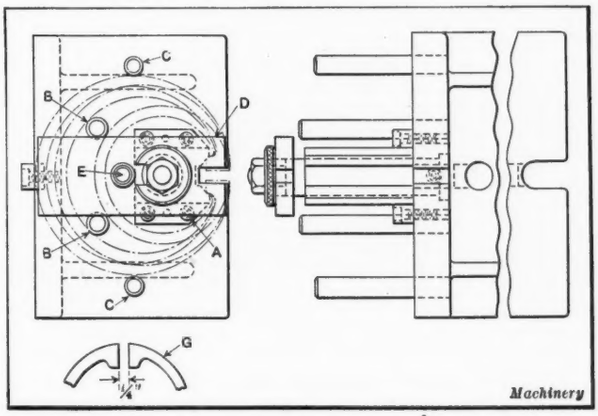
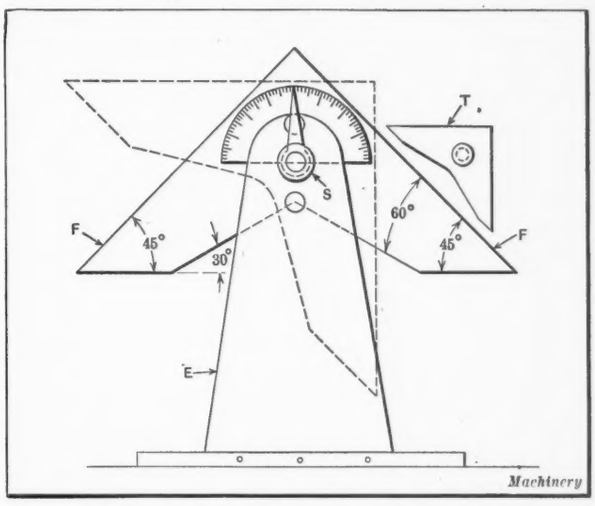


Fig. 5. Milling Fixture designed for milling Slot in Three Sizes of Brake Rings

* * *

COMBINATION TRIANGLE AND PROTRACTOR

The combination stand and triangle here illustrated is not manufactured commercially, so far as the writer knows, although a number have been sold in a somewhat restricted way. The combination as thus manufactured, however, is not provided with the feature that is to be here emphasized. While any angle from a horizontal or vertical surface may be obtained with this instrument in order to draw opposite angles of other than 45 degrees, as for instance, in a screw thread or dovetail, it is necessary to loosen the knurled nut *S*, and after much difficulty and some uncertainty, reset the triangle in position to draw the opposite slope of the angle. On account of the projecting of the knurled nut *S*, it is impossible to turn the triangle over to obtain the opposite

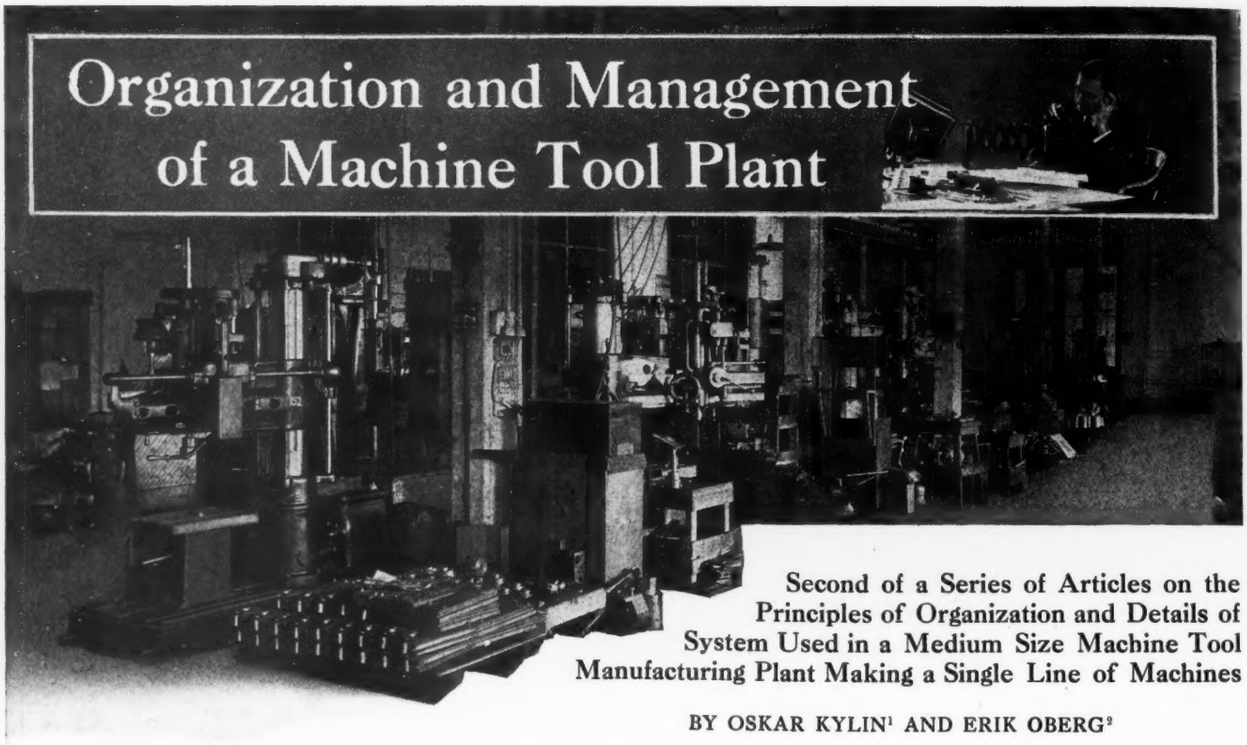


Combination Triangle and Protractor with Indicator Hand

angle, and even if it were, it would not lie against the surface of the paper on account of the stand *E* being assembled against the side of the triangle and away from the paper. To overcome this drawback, an ingenious draftsman conceived the idea of scribing a protractor on the celluloid triangle, as shown in the illustration, having the 45-degree graduation on the perpendicular center line when set as shown, the sides forming 45-degree angles with the straightedge. The other graduations were advanced in the regular way on each side of the center line from 45 to 90 degrees. The nut *S* was then removed, and a clock hand fastened to the screw vertically, and so that it would not turn.

The two parts, the stand and the triangle, were then reassembled by means of the nut. With this addition, when the triangle is turned to the position shown by the dotted lines in the illustration or when reversed, as the case may demand, the hand will indicate that the working edges *F* of the triangle are perpendicular to, or horizontal with, the straightedge. With this arrangement, opposite or complement angles can be laid out accurately without difficulty. The stand contains three holes located at different distances from the base so that the triangle can be set at different heights as desired. The small triangle *T* which goes with the outfit is very useful, and when the large triangle is adjusted to the desired base angle, lay-out and similar drawing work is greatly facilitated. F. R. D.

Organization and Management of a Machine Tool Plant



Second of a Series of Articles on the Principles of Organization and Details of System Used in a Medium Size Machine Tool Manufacturing Plant Making a Single Line of Machines

BY OSKAR KYLIN[1] AND ERIK OBERG[2]

IN the first installment of this series of articles the principal functions of management and the application of the managing board to a machine shop organization were described. In addition, the methods and systems of the engineering department and the procedure in the design of new machines were described. The general organization and duties of the planning department were also reviewed. The present installment will deal with the work of the planning department in relation to time study and rate setting, and will describe the tool-room system of the Foster Machine Co.

Time Study and Rate Setting

Before the machines decided upon by the managing board can be built in the factory, time studies must be made and piece rates must be established, because all the work is paid for on a piece-work basis. It is of importance that this work be done completely before the first lot of machines is put through, so that there will be no need for extensive changes in the piece rates afterward. Time studies are made at the same time that the jigs and fixtures are completed and tested. They may be divided into plain time studies and complete time studies. The plain time study involves merely obtaining the total setting-up time and machining time required for doing the work in a certain predetermined manner, while the complete time study may be said to involve a study of the time required for doing the work in a number of different ways in order to determine the most rapid method possible, and includes not only the determination of time, but also the preparation of instruction sheets, giving complete details as to the methods of tooling, methods of grinding the tools or cutters, and all other details that will increase the production or decrease the production time. Plain time studies are made for all parts that are put through the shop in the manufacturing departments, in order to determine the piece-work rates. Complete time studies are made only in cases where parts are put through in great quantities.

Plain Time Study

In order to make a proper time study for setting piece rates, the time-study man should have at his disposal such facts and data as, for example, the time required for putting a scroll chuck on the machine spindle; for mounting a turner on the turret; for adjusting tools; for indexing from one position to another; for moving the carriage or the cross-slide a certain distance, etc. It is also necessary to know the quality of the cutting tools that are to be used and the feeds and speeds to be employed. Data of this kind are tabulated for the convenience of the time-study man, so that most of the time study can be made in the office, after the preliminary unit times referred to above have been obtained by actual experiments in the shop.

In carrying out this time study, attention must be paid to the number of parts to be made. In a factory making

[1]Associate General Manager and Chief Engineer, Foster Machine Co., Elkhart, Ind.
[2]Editor of MACHINERY.

PLAIN TIME STUDY

MACHINE 1B Turret Lathe (No Special Tooling)

NO.	SUB-OPERATION	TOOLS, ETC.,	R. P. M.	SURFACE FEET PER MIN.	FEED	TIME
1	Place in Chuck					1
2	Bore out Center	M-113	86	68	0.003	1.1
3	Fin. Bore + Face	M-102	64	73	0.011	1.2
4	Remove from Chuck					.2
						3.5
					+10%	.35
				Total	time	3.85

Fig. 12. Card for recording Results of Plain Time Study, giving Time, Speeds and Feeds, Tools, etc.

OPERATION TIME CARD

OPER. NO. 1 NAME Collar TRAC. NO. E-1262 PART NO. 12517

METHOD	SET-UP TIME	MACH'NG TIME	TOTAL TIME FOR EACH P'CE	DATE	NOTES
RECORD					
COMPARISON					
OBSERVATION					
PLAIN TIME STUDY	3.5m.	3.85	5.25	10-17-18	actual mach time by test 3.5 min.
PLAIN TIME STUDY TEST					
COMPLETE TIME STUDY					
COMPLETE TIME STUDY TEST					Machinery

Fig. 13. Time-study Card prepared on the Basis of the Manufacture of Twenty-five Pieces

RATE CARD

NAME Collar TRAC. NO. E-12 612 PART NO. 12517

OPER. NO.	NAME	DECRIPTION	PRICE, CENTS
1	Screw Mach.	Drilling, Turning & Facing	27
2	Drill Press	Drill & Tap	4
			Machinery

Fig. 14. Rate Card employed giving Actual Rate per Operation

NAME Collar TRAC. NO. E-12612 PART NO. 12517

PIECE PRICE

OPERATION NO.		1	2				
PRICE, CENTS		27	4				
ORDER NO.	NO. OF PARTS	RECORD TIME EACH					
M-175	50	32 m.	5 m.				
M-251	25	35 m.	55 m.				
							Machinery

Fig. 15. Record of Time required in Shop for Given Operations

machine tools in comparatively small lots, it does not pay to carry time studies to as advanced a point as it would in an automobile factory, for example. It is expensive to obtain the required data, and what is obtained must be worth, in dollars and cents, more than the savings that may be derived from its use. Much of the criticism of the methods of scientific management, time studies, and similar work, is due to the fact that poor judgment has been shown with regard to the extent to which such studies have been carried. If it costs more to obtain the information than can be saved by the knowledge thus obtained, it is evident that it is foolish to try to place the data on record. Good judgment must be displayed in all cases of this kind, and it is the manager's main duty to balance properly the expense involved and the benefits derived.

Instruction sheets are used to record the information obtained by the planning department, and are placed in the hands of the operator as one of the tools that the management provides. The object of the instruction sheet is simply to convey knowledge to the operator, so that he may be able to produce the work more rapidly than he could without the directions given.

Cards for Recording Results of Time Study

Fig. 12 shows a card used for recording a plain time study relating to the machining of a certain piece. It will be noted that the operation is divided into four elements and the time for each element is given. Speeds and feeds are also included for the machining operations, and numbers designating the tools used are shown. The unit times are added, and 10 per cent of the sum is added to give the total time on which the piece-work rate is based.

Fig. 13 shows the time study card as prepared on the basis of the manufacture of twenty-five pieces. This time card is provided with spaces for recording all the information that may be of interest in connection with the production of the part, with regard to the time study, rate setting, or cost systems. The first line headed "Record" provides space for filling in the best time that may be obtained for the operation in hand. There is a time card for every individual operation. The line denoted "Comparison" would give the time if obtained by comparison with a similar piece made in the past. The line denoted "Observation" would give the time in case it had been determined by actual observation of a man doing the work in the shop. The line denoted "Plain Time Study," which is filled in, in this case, indicates that the time is based upon and computed from a plain time study, such as indicated by Fig. 12. "Plain Time Study Test" indicates that the time, if recorded on this line, has been obtained by an actual time study test in the shop. "Complete Time

INSTRUCTION SHEET

NAME Collar TRACING NO. E-12460 PART NO. P-12413

OPERATION NO. 2 MACHINE 1-B Screw Machine

NO.	SUB-OPERATION	TOOLS, ETC.	R. P. M.	SURF. FEET PER M.	FEED	TIME
1	Chuck	1 7/8" Collet in Automatic Chuck				0.2
2	Center	1/2" Center Drill Holder Chuck No. 12217 No. 141	149	20	Hand	0.2
3	Drill	15/16" Drill in Mult. Turning Head No. 147 Bush. No. 103-B	149	37	0.014	0.1 1.4
	Rough-Turn 3/4" Dia.	Tool No. T-4 in 107-A-Holder in Mult. Turning Hd. No. 147	149	127	0.014	—
4	Bore	Boring Bar No. T-16 in Mult. Turning Hd. No. 147 Bush. No. 103-B	149	38	0.014	0.1 1.4
	Finish-Turn 3 1/4" Dia.	Tool No. T-5 in No. 107-A Holder in Mult. Turn. Head No. 147	149	127	0.014	—
	Rough-Face	Tool No. T-17 in Square Turret	149	127	Hand	—
	Finish-Face	Tool No. T-17 in Square Turret	149	127	Hand	—
5	Ream (Turret Free)	1" Reamer in No. 141 Holder with Bush. No. 103-B	149	38	Hand	0.1 0.7
6	Piece Out		—	—	—	0.1
						4.3
						Set-up 1.0
						10% 0.4
						5.7

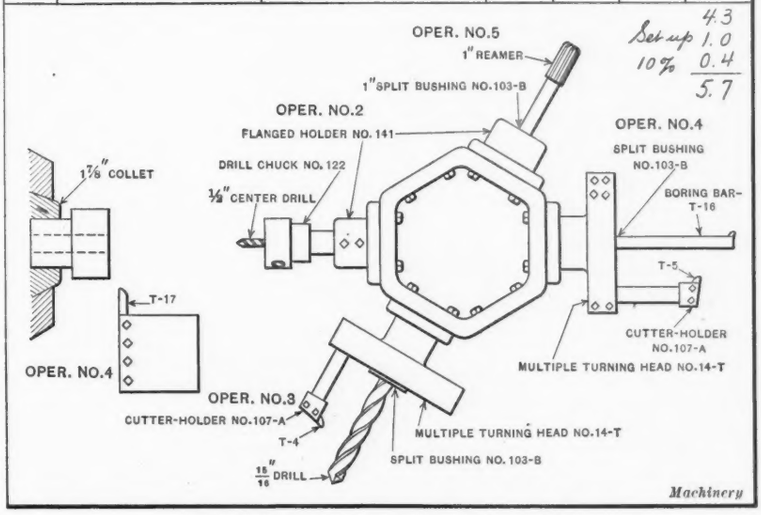
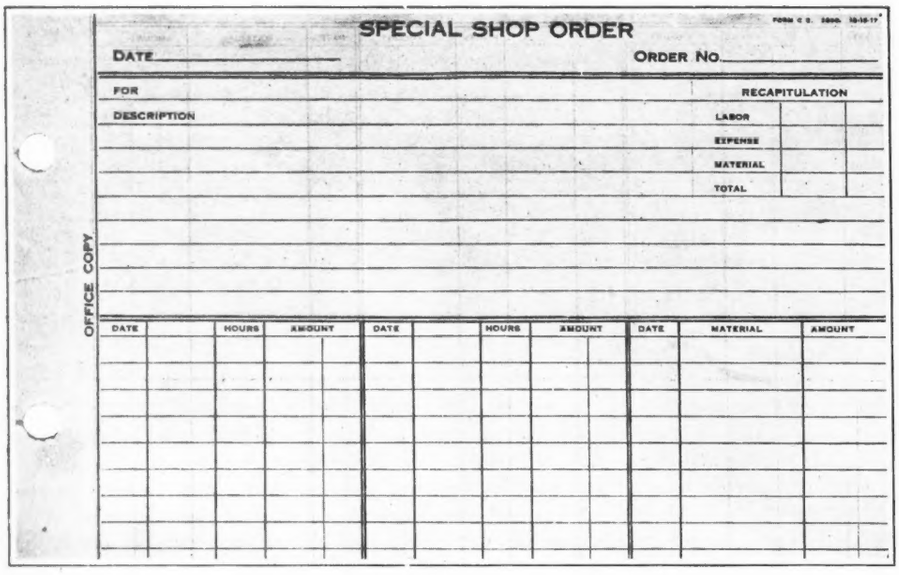


Fig. 16. Example of Instruction Sheet employed


SPECIAL SHOP ORDER

DATE _____ ORDER NO. _____

FOR

DESCRIPTION

RECAPITULATION

LABOR

EXPENSE

MATERIAL

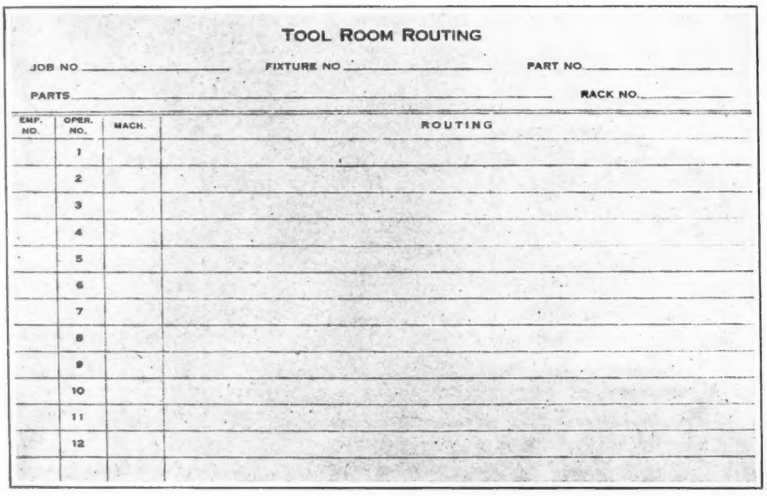
TOTAL

OFFICE COPY

DATE		HOURS	AMOUNT	DATE		HOURS	AMOUNT	DATE	MATERIAL	AMOUNT

Fig. 17. Front View of Special Shop Order, Office Copy

Study" indicates that the time has been obtained by a complete comparative study of the unit times required for making the piece; and "Complete Time Study Test" denotes the time determined by an actual test of the time required for performing the operation in the shop. When a plain time study has been made and a test has been performed in the shop to find out whether or not the time can be met under actual shop conditions, a note to that effect may be made in the last column under "Notes," as indicated.


TOOL ROOM ROUTING

JOB NO _____ FIXTURE NO _____ PART NO _____

PARTS _____ RACK NO. _____

EMP. NO.	OPER. NO.	MACH.	ROUTING
	1		
	2		
	3		
	4		
	5		
	6		
	7		
	8		
	9		
	10		
	11		
	12		

Fig. 18. Tool-room Routing Card

After a time study has been made by the time-study man, a special tester is employed for making an actual test of the time study, after which the rate setting is based entirely upon the time study, a certain standard rate per hour having been adopted for different types of machines. The rate setter also determines the type of man required for performing the work. When a skilled man is required, a higher standard rate must be adopted than when the work can be handled by an unskilled man. Fig. 14 shows the rate card employed, which gives the actual rate per operation for a given part, indicating how this information is recorded.

Fig. 15 gives a record of the actual time required in the shop for doing the work. In this case, the same piece as referred to in Fig. 14 has been taken as an example. Fig. 16 shows the type of instruction sheet employed, indicating the kind of information given and the method of showing the tooling arrangement.

In determining the standard unit times for each operation, the time-study man also employs a stop-watch for obtaining additional data and points on setting-up time. The stop-watch is also used in testing the productive qualities of tools and cutters, and the value of different cutting angles. When the stop-watch is used for determining the actual time required for setting up or machining, the man doing the work is always informed of the fact that a test is going on, as it is well known that this creates a better feeling. There should be no effort made on the part of the management to make a secret of the fact that all piece rates are based upon time studies, and the methods of making these time studies should be understood by all the men in the shop. When this is the case, there will be found to be no objection to this system, because it will be recognized that the system is used merely in order that fair compensations may be offered to all.

Bonus Paid in Addition to Piece-work Rates

In addition to the regular piece-work rates, a bonus of 5 per cent of the total earnings is paid to every man who has a perfect record for a period of two weeks—a perfect record meaning that the man has not been late nor absent for that

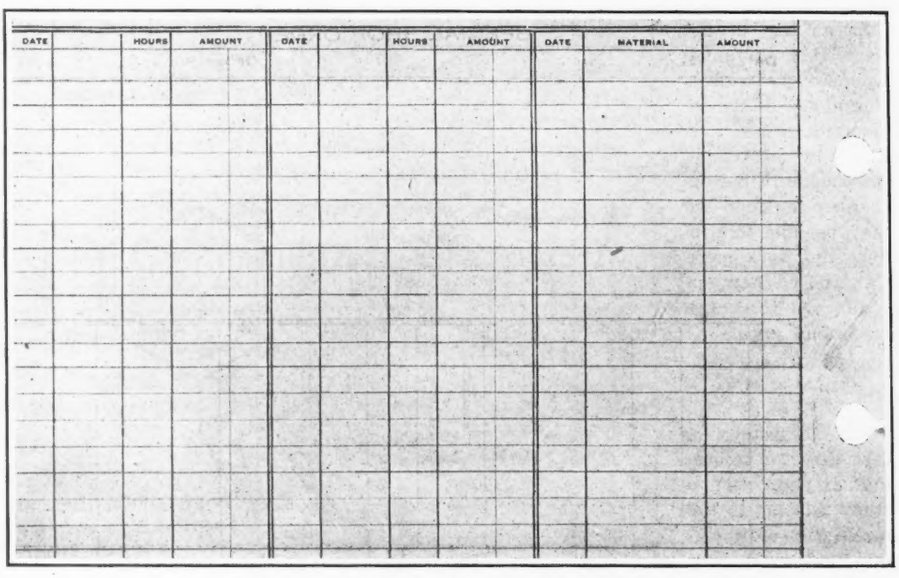
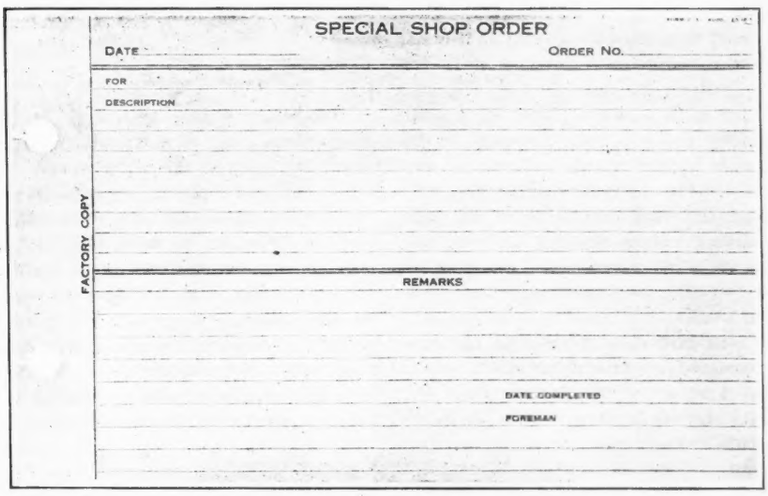

DATE		HOURS	AMOUNT	DATE		HOURS	AMOUNT	DATE	MATERIAL	AMOUNT

Fig. 19. Back View of Form shown in Fig. 17

period. The foreman is also paid a bonus which is based on the average production per man per month; this is based, in this case, however, not upon the production in each department, but upon the production in the whole shop. There are several advantages to be gained by basing the bonus on the complete shop production. In the first place, this method insures thorough co-operation between departments, because each foreman is anxious to see that the work passes through not only his own department at a rapid rate, but also the remainder of the shop; and he is, therefore, willing to aid in making it possible to pass it through other departments at an equally rapid rate. Furthermore, it would be difficult to determine accurately the share of each foreman if the production in his own department only were to be considered as a basis.

A basic minimum production per man per month has been established, and when the actual production exceeds this minimum, the foremen receive a percentage of the value of the excess production. The value of the production is estimated by using the selling price as a basic figure. The payment of bonuses to the men for perfect records with regard to punctuality and attendance, and to the foremen for increased production, has shown good results.


SPECIAL SHOP ORDER

DATE ORDER NO.

FOR

DESCRIPTION

FACTORY COPY

REMARKS

DATE COMPLETED

FOREMAN

Fig. 20. Special Shop Order, Factory Copy

Tool-room System

The tool-room is placed directly under the engineering department, because the work of the tool-room is simply a part of the planning work for the manufacturing departments, and, for that reason, should be in charge of the department responsible for the planning. The tool-room is under the direct charge of a foreman. When drawings for experimental machines, jigs, fixtures, or special tools for outside customers are received by the foreman, he and his clerk order the material required for the machines or tools from the raw stock-room. Castings are ordered by the purchasing department, to which the foreman of the tool-room sends a memorandum. When the material arrives in the tool-room, it is placed in racks for temporary storage. The foreman then acts as his own planning department in that he studies the methods of machining each part and makes up a tool-room routing card as shown in Fig. 18, which records the information required for completing the work and describes the different operations to be performed. All work done by the tool-room is ordered on what is known as a special shop order, of which there are two copies—one office copy, a front and back view of which is shown in Figs. 17 and 19, and one shop copy, shown in Fig. 20; the latter has a plain back.

The tool-room routing card, shown in Fig. 18, is not made on a tracing as the factory routing card is, but on ordinary paper, because it need not be used again, and hence, no duplicate records or blueprints are required. When the routing has been indicated on the card by the foreman, the routing card passes to his clerk, who makes out the neces-

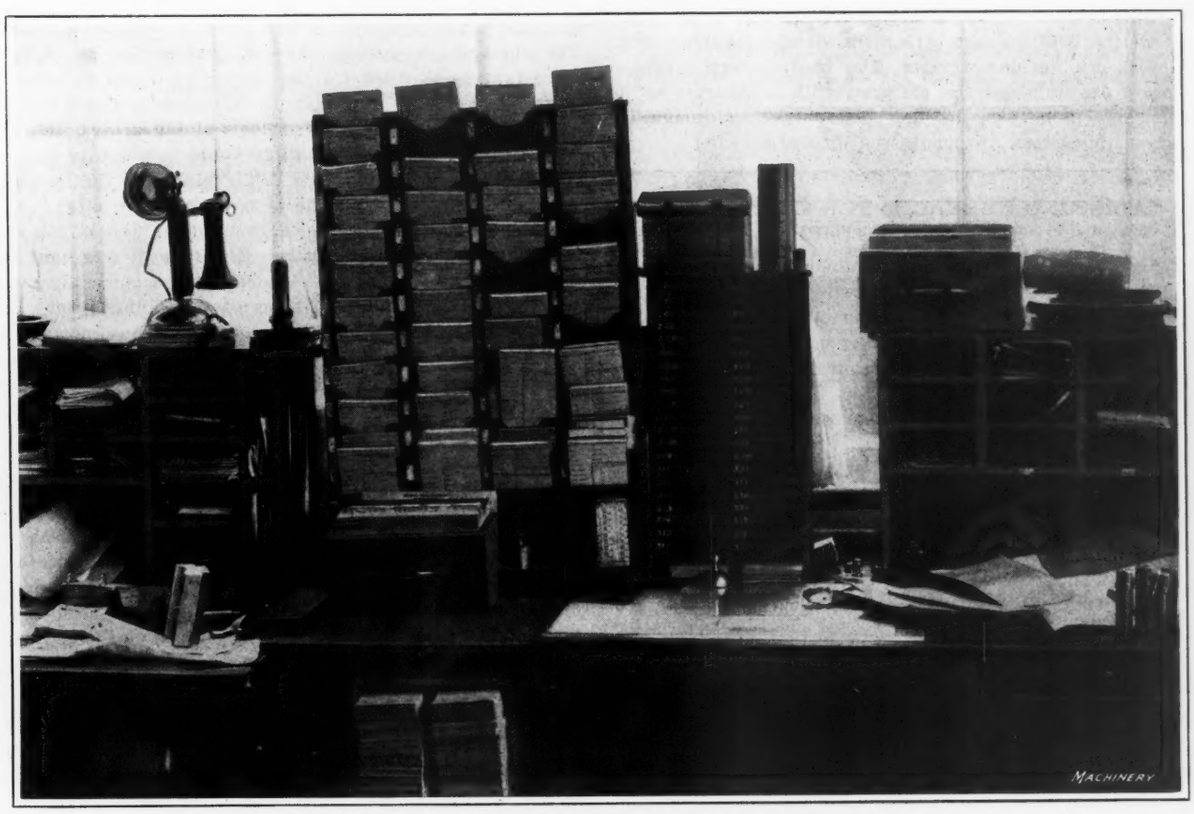


Fig. 21. Rack in Tool-room for Time Cards and Tool-room Foreman's Records

sary time cards, which are similar to those used in the shop. These time cards are placed in a rack as shown in Fig. 21. This illustration shows the tool-room foreman's desk and the means provided for keeping his records. In the rack shown, the time cards for each operator have a separate place, and the various jobs are put into the rack in the order in which they are to be performed, so that, as each job is completed, the toolmaker takes the next card from the rack and proceeds with the work described on that card. He returns at the same time the time card for the completed job to the foreman, who, in turn, passes these cards to the time-keeping and cost-accounting departments. Day rates are paid for all tool-room work.

The tool-room has its own inspection room and all tools, jigs and fixtures are inspected in this department, which was shown in the March number of MACHINERY, page 611, in Fig. 7. Tools made for outside customers are tested by actual service for some time. The tool-room is divided into three distinct departments: The machining department, where the actual machining work on tools, jigs, and fixtures is done; the assembly department, where tools, jigs, and fixtures are assembled and tested; and the department for building and testing new machines, as well as the three sample machines that are built for testing a new set of jigs and fixtures when these have been made and before they are actually used in the manufacturing departments, this practice having been referred to in the preceding number. The building and testing department with three sample machines on the floor was shown in Fig. 10, page 613, of the March number.

Pattern Shop

The pattern shop is under the direct supervision of the engineering department, because the making, storing, and keeping of patterns is part of the planning department for the actual manufacture of the machines. A pattern may be considered simply as a model or drawing in concrete form, for the making of castings; hence, the engineering department should have charge of the patterns and the pattern storage in the same way as it has charge of the drawings and the drawing files. Furthermore, when changes are to be made in patterns, this work must be referred directly to the drafting-room; hence, the work of the pattern shop and that of the drafting-room are more closely connected than the work of other departments. The drafting-room furnishes separate drawings for the patterns, with a separate set of dimensions to be used by the patternmaker, although the finished dimensions are also given on the drawing.

* * *

ALIGNING SURFACES FOR SETTING UP ELECTRIC MOTORS

For a light load, and when used under the most favorable conditions, an electric motor can be aligned by eye with sufficient accuracy to give satisfactory results. However, when the machine consumes all the power supplied by the motor and belt, and when conditions require that the motor be placed at some distance from the machine, satisfactory results cannot be obtained in this manner, except by chance or after some experimenting.

While some electric motors are provided with planed feet and ride in planed bases, guided by machine grooves or ways, there are many which have only unfinished cored bases, the holes in which carry loosely fitting fastening bolts. For such motors, if two faced leveling spots were provided on the top of the motor frame in some convenient place, much difficulty would be obviated. Also, if the ends of the motor feet were faced, two aligning surfaces would be provided a good distance apart. These improvements would not be costly, and would effect a considerable saving in the installation of the motor, as well as furnishing a ready means of checking up its alignment and seating, without disturbing any part of the drive, whenever a settling or shifting in the position of the motor might be suspected. D. A. H.

JOB ANALYSIS

BY A. J. SCHNEIDER

Employment Manager, Cincinnati Planer Co., Cincinnati, Ohio

Job analysis may be defined as the work of studying the requirements of a given occupation so that the best applicant is placed at the right work. If the employment department is to be placed upon a scientific basis, job analysis must be considered one of its functions; in fact, in the writer's opinion, it is one of the most important matters with which the employment department has to deal. Perhaps the best work that has been done along this line is that of a large electric manufacturing plant in Pennsylvania. This company has made a study of occupations, operations, and pay rates with a view to standardizing them. In other words, the company has prepared a standard list of occupations, with complete written requirements for each, carried out in great detail. A copy of these standard lists is placed in every department so that there may be a common understanding throughout the plant of the requirements of each occupation.

To do this work properly, the employment department must have the cooperation of the management and the department heads. This cooperation being assured, the first step in job analysis is the preparation of a proper application blank. In a shop where there may be from twenty-five to a hundred standard occupations, it is evident if there is but one application card, this card can take care of the job analysis only in a general way. The writer, in his own work, endeavors to obtain the general information that is required for about 90 per cent of the occupations in his plant on the application form. After having obtained the necessary data, the applicant is given such information as he may need concerning the job for which he is being hired, and to do this a scientific study of the jobs or occupations must be made.

Job analysis may be considered to be specifications for buying labor, and should be used the same as standard specifications are in buying materials. We want to buy service. We know what service we expect; if we do not know, we had better not buy until we do know. That is the reason for job analysis. In order to have a complete job analysis, it is necessary to have a medical department and to require the applicant to pass a physical examination so as to be sure that he is fitted for the particular work at which he is to be employed. For example, a man with flat feet would not be able to work as a trucker walking around the shop all day; a physical examination would reveal this fact and would prevent the man from being placed at that work, or at other work for which he is not physically fitted.

A condition somewhat aside from the subject of job analysis might be mentioned here. The type of applicant generally known as a "floater" is sometimes a good talker, and having had a great deal of experience in hunting jobs, may know better how to get one than the man known as a "sticker," who makes very few changes and is likely to be nervous and backward. For example, in one case an applicant told the writer that this was the first time in twenty-seven years that he had been looking for a job and he did not know what to say or how to go about it. That was in itself a good recommendation and the man was hired. The employment manager must remember that a poor talker (that is, a poor salesman) may be a very good mechanic, and that those who are clumsy at getting jobs may have fine experience in running planers. It should be kept in mind that the applicant's specialty is the work he does—he has not been trained in the getting of jobs or the selling of his services.

* * *

The restoration of Alsace-Lorraine to France will cause an increase of 105 per cent in the output of iron ore, 65 per cent in the production of iron, and 50 per cent in the output of steel within the new boundaries of France.

Trend of the Machine Tool Market

THE situation in the machine tool market has not changed materially during the month. The demand for some lines of machine tools, such as grinding machines and certain types of milling machines used in automobile, tractor, and agricultural implement plants has been fairly good, whereas the demand for such lines as lathes and planers is very light. It seems, however, that there is a great potential demand for machine tools from the motor car builders in Detroit and other automobile building centers, which will soon be felt in the machine tool trade. Of course, some lines of machine tools will not be affected by this, as the demand of the automobile plants is rather restricted to certain fairly well defined lines of machine tools.

Inquiries in all lines are very heavy, which is taken to indicate a large prospective demand, but buyers are slow in actually placing orders. This condition is partly due to a belief that machine tool prices will be reduced; partly to the fact that many concerns are not in a position to buy until the Government has settled their claims for war work produced in their plants; and partly to the fact that many plants are not yet ready to resume normal peace production, but are laying their plans and making the necessary inquiries for the equipment that will be necessary.

The machine tools owned by the Government and which have not yet been placed on the market in any large quantity are also apparently furnishing one of the reasons for slow buying. It is believed that customers are not placing orders at present hoping that they will obtain some of the machines they need from the stocks in the hands of the Government, at a price that will warrent delaying buying at the present time. Some of the railroad shops have already obtained some of these government-owned machine tools and it is likely that the railroad shops will take over a great many more of these machines.

During the war period no manufacturers had an opportunity to make any machines for stock, and some are welcoming a brief period of less active business so that they may be able to place their factories upon a more normal basis for efficient and economical production, and get some stock ahead for their dealers here and abroad; but it is evident that with the present capacities of the machine tool plants it will require a comparatively short period to accomplish this result.

There is quite a general demand for machinists' small tools. Much of this comes from dealers whose supply was completely exhausted during the war; but in addition to the replenishing of stocks on the shelves of local representatives of the small tool manufacturers, there seems to be a brisk demand from the ultimate consumer.

Government Delay in Settlement of Claims is a Serious Matter to the Industries

Possibly there is no one factor that is retarding the return to normal business conditions more than the delay on the part of the Government in settling the claims of manufacturers for completed or partly completed work. It is reported that some of the automobile companies that were manufacturing either truck or airplane parts have very large unpaid claims against the Government, and that these companies would be ready to do a substantial business if their claims were promptly paid.

One large concern that had important government contracts has gone into the hands of the receivers, but it is alleged that the company would be fully solvent if it could only obtain a prompt settlement with the Government for the work done for the Ordnance Department. If the Government further delays these settlements of claims, possibly there will be a great many other firms that will be placed in the same position, and it is quite certain that the return to normal business conditions is greatly retarded by the fact that manufacturers have large investments in materials purchased to complete government contracts on which they cannot realize, and the payments for which are being held up. Naturally these concerns cannot come into the market as buyers, even for materials and machines that they may urgently need, until these claims have been settled.

The method by which the Government is collecting the taxes is also interfering with the rapid return to normal business, as large amounts of cash are withdrawn from trade channels at the very time when they are most needed for the reconstruction work to be done.

Prospective Demand for Machine Tools in Detroit

Machinery builders and dealers who have been making a study of market conditions in Detroit during the past month report that there is certain to be an urgent demand for machine tools from this industrial center in the near future. Opinions differ as to when the automobile manufacturers, who are the chief buyers of machine tools in Detroit, will be in a position to come into the market. The demand for machine tools for use in motor car factories does not merely represent the replacement of worn out or obsolete machines; although no definite announcements are yet forthcoming, it is understood that among the important corporations engaged in the manufacture of motor cars, there are some far-reaching developments under consideration. These are understood to involve the making of substantial additions to the existing plant capacity, and, what is most important to the machine tool builder, the purchasing of a large volume of machinery.

The Second-hand Market in Machine Tools

There has been but little change in the second-hand market of machine tools. Generally speaking, it may be said that the market is normal. There is as yet no excess of good second-hand tools on the market, and the only interference in this direction comes from the machines owned by the Government which have not as yet been placed on the market. Both manufacturers and dealers agree that it would be the best thing to have these machines disposed of at once so that the manufacturers would know exactly the state of the market and could begin making their plans without the constant uncertainty that will remain until these machines have been disposed of.

Most of the machines offered for the second-hand market by war material manufacturers to dealers are of an inferior nature—either so old or so badly worn or severely used that the dealers do not want to handle them, and generally these machines are finally consigned to the scrap heap. One large manufacturing concern that had been engaged in munition manufacture advertised a large line of second-hand machine tools, but found that they could not be disposed of on account of their condition, and finally scrapped them all.

It seems to be rather generally conceded that there is little demand for second-hand machine tools. Possible buyers of this class of machinery are withholding their orders, such action being based upon judgment that prices for second-hand equipment will be substantially reduced as a result of the dismantling of many munition plants and the sale of the equipment. Furthermore, the larger manufacturing plants do not buy second-hand machines in normal times, preferring always to equip with new machinery.

APRIL, 1919

MACHINERY

VOL. 25 NO. 8

Published Monthly by
THE INDUSTRIAL PRESS
140-148 LAFAYETTE ST.
NEW YORK

ENGLAND
51-52 CHANCERY LANE
LONDON

CABLE ADDRESSES
MACHINERY, NEW YORK
MACHTOOL, LONDON

ALEXANDER LUCHARS, President
MATTHEW J. O'NEILL, Treasurer
ROBERT B. LUCHARS, Secretary

EDITORIAL
ERIK OBERG, Editor
FRANKLIN D. JONES EDWARD K. HAMMOND
Associate Editors

Secretary Redfield has appointed Alexander Luchars, publisher of MACHINERY, as U. S. Trade Commissioner to Great Britain and Continental Europe for the purpose of studying conditions affecting the sale and use of American machine tools and supplies there. Special arrangements have been made so that Mr. Luchars' reports will be mailed promptly to our manufacturers by the Department of Commerce. He will sail on the 26th of this month.

* * *

INDUSTRIAL AMERICANIZATION

The war has brought home to manufacturers, as nothing else could, the importance of Americanizing their foreign-born workmen. They have found that the loyalty and the interest in their work necessary for real efficiency can be expected only from men who are thoroughly identified with our country, who expect to remain here and to make the most of the opportunities America offers. For that reason many manufacturers have recognized the importance of aiding their foreign-born employes to obtain citizenship, not only as a patriotic duty, but as a commercial proposition.

It has always been recognized that the efficiency of the southern European workman has not been as high as that of the northern European immigrant or of the native workman. However, in plants where a systematic effort has been made to increase the efficiency of the lowest grades of labor, it has been found possible to Americanize the southern European immigrants so that they have become more valuable as workers, while their standard of living has also been raised.

Efforts are being made to provide better housing conditions for the foreign-born and American workers alike, the former being given equal consideration with the latter in hours and wages, and special help being given them to become citizens, both by allowing the necessary time required to obtain the papers and by aiding them in meeting the legal requirements. Efforts are being made to teach English to those who do not understand it, so that they may thereby become interested in American ideals and institutions.

Industrial Americanization is not entirely a philanthropic movement. While patriotic, it is tinctured with commercialism and aims at greater production, greater labor efficiency and industrial peace, understanding and harmony.

* * *

STANDARDIZED PRODUCTS FOR FOREIGN TRADE

Undue importance has been given to some of the statements on foreign trade relating to the making of products to suit the ideas or whims of the customer. It has been repeatedly stated that American manufacturers must pay more attention to the customer's wishes or practices if he is to enjoy a large foreign trade. This may be true in some lines of manufacture, but it is quite certain that it does not apply to machine tools or to the general machinery lines.

The standardization of machine tools and other devices has made it possible for the American manufacturer to turn out a superior product at a reasonable selling price, and the foreign buyer is much better served by being supplied with such a product at a comparatively low cost than with a special product at a high cost. In addition, there is a distinct saving in connection with repair parts, duplication of machines to perform the same or similar work and in the adaptation of labor to operate the machines.

The idea that the American manufacturer should always try to meet the wishes and preferences of the foreign customer is founded upon the opinions of salesmen of general merchandise who follow the lines of least resistance. It is, of course, much easier to sell the customer something that agrees with his own preconceived ideas, even if something else might answer his requirements better; but it takes real salesmen and men of some technical knowledge also, to convince a customer that a standard machine will better meet his needs than a special design that he may have in mind.

During the early part of the war, when the supply of machine tools from Germany was cut off from the rest of Europe, many European buyers came to America insisting upon obtaining machines exactly like the ones they had previously been buying in Germany, and saying that their customers wanted exactly such machines. Of course, American manufacturers could easily convince them that the standard American machine tools were superior in quality and would answer the requirements equally well or better. When the seller goes into the customer's own factory, it may sometimes be more difficult to convince him, but that is one of the tasks ahead of the men who are to sell American machine tools in Europe. They should convince European customers that the standard American machine tools can be adapted to practically all the uses for which the Germans in the past were wont to supply special machines.

* * *

TENDENCIES IN JIG AND FIXTURE DESIGN

In the past, the general practice was to design a complete jig or fixture for every part that was to be machined by the aid of special tools. This was a convenient way for the designer and appeared to be the only feasible and practicable method. But during recent years, there has arisen a tendency to use what may be termed "universal" jigs and fixtures. For example, instead of making a milling fixture for every part to be milled, special vises have been designed in which only one or more jaws need be changed to adapt the vise to another piece. In most cases, drill jigs still are made as in the past, but a tendency is evident to devise methods to eliminate the cost of individual jigs for every piece. The whole trend is toward greater economy in production, and as more thought is given to the important subject of providing efficient and at the same time economical tooling equipments, it is likely that many new ideas will still be developed, so that the required accuracy and interchangeability can be obtained without the expensive multiplicity of jigs and fixtures that at one time seemed necessary, but that now, in many instances, have been partly eliminated by newer methods or by new applications of old principles.

Machine Tool Prices

Few Manufacturers Favor Price Reductions Under Present Conditions

By ALEXANDER LUCHARS, Publisher of MACHINERY

This question is of such importance that we felt warranted in making an extended inquiry regarding it, and quote briefly from some of the interviews and letters received, which cover every phase of the subject. The various opinions of American machine tool manufacturers, almost without exception, are represented in these quotations, which contain ideas well worth the consideration of all, as they embody the judgment and experience of the industry. Many were omitted on account of lack of space, and because they are similar in substance. The information was given to us with the understanding that no names should be used.

From a Prominent Manufacturer Who Takes One Extreme of the Various Opinions

The slowing up of business in this country is, to a certain degree at least, due to the general idea prevailing that prices for all sorts of commodities must come down before there is normal buying.

While it is true that present labor prices and material prices have not receded to any appreciable extent, and the present decreased production of machine tools has increased the overhead, I feel that machine tool manufacturers like other manufacturers who have been selling their product in the past few years on an abnormal price basis, have a responsibility in the matter of cooperating with other manufacturers to bring all selling values down.

Machine tools like everything else should be sold on the basis of cost plus a reasonable profit. The present prices of machine tools, when running on a normal basis, are on a level of profit higher than competition would permit. Manufacturers cannot expect to make a profit, at least cannot expect to maintain a normal profit, during the period of reconstruction in which we find ourselves. We must be willing to accept the loss that is unavoidable under the present abnormal business conditions.

Competition in machine tools has been increased first of all through the enlargement of old concerns, and the addition of many new ones. Competition for European business has been made more difficult, because during the war many new concerns in foreign countries have been developed, and the American tool builder must take into account the prices at which these new concerns are offering their machines.

In conclusion—high as costs are at present, they do not warrant present selling prices if consideration is given to the obligation of the manufacturer to assist in establishing normal buying. A substantial reduction in prices at this time might sufficiently stimulate business to enable manufacturers generally to maintain at least a substantial portion of their organization. The cost of the disintegration of an organization in a machine tool plant will be immeasurably greater than a reduction in the sales prices of machines.

From Four Widely Known Machine Tool Dealers

As you no doubt know, the advance in machine tools has been from 40 to 150% of the pre-war prices, and in one or two instances possibly about 200%. In some of these cases the advance in price also covers a change in design of the machine, but in most cases it does not. We do not see how there can be any horizontal decrease in the price of machine tools, as the amount of advance was different with the different concerns. Nor do we see how, with the present prices of labor and material, the prices of machine tools can go back to the pre-war period. We doubt very much if a great reduction in price would stimulate business very much at the present time; but we also feel that a number of concerns who have advanced their prices abnormally, due to abnormal conditions, should return to a fair basis, as these conditions change.

A reduction from the present price represents a much larger percentage in the previous advance (that is, 25% reduction now represents 50% advance, previously) and this point should be taken into consideration before revising the price.

I think it would be wise to hold to present prices until an equitable settlement is reached with the Government concerning cancelled and partially completed orders for machine tools, which aggregate a large sum, and when reductions are made that they should be large enough to stabilize prices for some time to come, which should tend to stimulate buying.

It is my opinion that any given percent from the prices in force, as of January 1st, 1919, will not come anywhere near representing, in a uniform way, true values, as would be true if, in place of making a reduction from the 1918 prices, some predetermined percent was added to the prices in force in 1915.

Considering the machine tool line in its entirety, it is my opinion that the prices in force in 1915, quality, weight, design and accuracy considered, accurately represented the true worth of various kinds at that time. Since then, or during the war period, while some manufacturers were very conservative in their advances and, in fact, might be credited with advancing only as conditions made it necessary, there are others who advanced prices based on conditions, regardless of costs, with the result that the advances varied from, say 80% to in excess of 300%.

To my notion, it would not make so much difference whether you added 75% to the 1915 prices, or 100%, or even 125%; for, as I view it, all it would mean, any way, would be just to put things on a firm foundation and have a starting point, but I am under the impression that 100% would come nearer meeting the existing conditions.

I cannot see why any company, who has during the last year or so felt justified in increasing its prices because conditions permitted, should be credited with an endeavor to stimulate trade by the fact of making what might be termed a reasonable reduction now, and possibly still leave a net profit in excess of some other company that has refrained from making any unnecessary advances in prices and therefore does not see its way clear to make any appreciable reductions in prices just at this time.

It is rather peculiar to us that the business we have secured since the first of the year has been almost exclusively in those tools on which there has been no reduction whatever. One or two of our principal manufacturers have reduced their prices from 10 to 20%. On those lines we have had no inquiries of any consequence; therefore, we have not secured any business covering tools at reduced prices. Personally the writer would prefer to see prices maintained until possibly the first of July, at least; and then if a reduction is made, have it a sufficiently large one that the buyer will know that there is to be no temporizing in prices. If some of the manufacturers reduce and some do not it is going to be a very difficult matter for the selling agent to secure orders on those lines where no reduction has been made.

From a Number of Manufacturers of Medium-sized Machine Tools of Various Classes

It is probable that in some cases prices have been raised to a point where there should be some adjustment to compare with those in other lines or with some of the other manufacturers. Labor shows no sign of reduction, nor would any manufacturer want to see it reduced while the cost of living remains at the present level. At this writing the cost of material has not dropped to any extent to make it appreciable in the production of machine tools in which labor forms a far more important factor than the material. In the more standard line of tools the increases that we made were fully warranted and their maintenance is likewise warranted under present conditions. There is no doubt that there will be a reduction at some time, and that time would be now if such a reduction would stimulate sales. But machine tool sales are made on account of efficiency and the results that the machines will give and because of an existing need, and not because the price is higher or lower.

We believe that too great haste in the reduction of prices at this time would be dangerous, and we do not believe that the lowering of prices 10 or 20% would have any effect

worth mentioning on the revival of business. It is not the high prices of machine tools that interfere with their sale at this time, but the unsettled conditions of business, all the natural consequences of the war, and the slowness of the government at making a settlement with those who were producing war material.

While the lowering of prices might stimulate business to a certain extent, we must consider that material and labor are still high and that we all have a large number of finished and semi-finished machines on our floors and considerable raw material bought at high prices; and if the price reduction were made in the finished machines we should all have to take a heavy loss, so that the most sensible conclusion is to stand firm on prices except in comparatively few cases where they have been raised abnormally, until our present stocks are reduced. If material and labor are to continue high we can see no reason for any considerable drop in the prices of machines for some time to come; but if prices are reduced now, they will have to remain where they are now placed, because it is very easy to reduce but difficult to increase without some real justification.

This problem, like most others, presents a great many angles. We believe that in certain lines of machinery where the prices have been raised more than necessary to cover the extra cost of labor and material plus a fair profit, there should be a prompt reduction of price sufficient to bring the price in line with the cost plus a fair profit. We do not think that this has been very general, and we do not favor a general and sweeping course of reduction in prices.

We do not believe that reduction in prices will stimulate buying; in fact we think a general reduction would tend to slow up buying, for people always hesitate to buy on a falling market. If prices have gone down some they reason that they will go down further, and they will hold off until prices are further reduced and until they seem to see a condition of stability in price.

One point which we consider very important and which we have tried to bring out in all of our negotiations with customers where the matter of change in price has been brought up, is that legitimate reduction in prices must be very slow and small in amount, because we are paying practically the same wages that we paid during the war period and we are paying nearly as much for material. Moreover, the cost of material in a machine tool is not a very large factor. We try to bring out the point that while a man might possibly save 10% by waiting six months before placing the order for a tool, he ought to earn much more than that 10% in his own factory by having the tool when he needs it and using it on his work. We think a manufacturer should purchase tools that will cut down costs, particularly when labor cost is as high as it is today. A good labor-saving machine tool ought to save 25% to 50% of its cost the first year, and a manufacturer who buys a machine tool right away and gets the benefit of it will come out better in the long run than if he waited a number of months to get a slight reduction in the first cost of the tool.

We have given the price question careful consideration, but up to date have not thought it advisable to reduce our prices, because the advance in our machines is not radical, and events so far would hardly justify making a reduction. In order to protect our customers we have guaranteed prices against a decline in our prices for a period approximating six months. We do not believe that any cut in prices, whether ten or twenty-five percent, would greatly stimulate the market at the present time. We are also of the opinion that there is going to be a pretty healthy demand for machine tools before the year is over, provided fancy prices have been eliminated.

We have not reduced prices and will not until either all machine tool builders do so, or conditions otherwise make it necessary in order to meet competition. Three or four direct competitors, however, have already reduced 10 per cent.

The reduction of prices to a no-profit figure was advocated at a meeting last week, and if put in effect it is more than apt to leave the impression, regardless of the expressed motives of the manufacturers who follow this plan, that the real motive is to stifle competition.

It is, in my opinion, unwise and unnecessary to resort to such practices in order to assist the machine tool industry and I believe that efforts should be made to convince all manufacturers of the wisdom of maintaining a fair profit price and to make a united effort for the general good of the industry.

The relation of the machine tool industry to national progress is well known. Each period of machine tool prosperity has been followed by the advent of improved tools. The machine tool builder under the fair competition of the past has used his profits to improve the basis of all production. Encouraged by continued fair profits, the results of their development should be more wonderful in the future than they have in the past, but progress cannot be made on a no-profit basis.

Those familiar with the percentage of profit in other industries express surprise at the low rate of profit in the machine tool industry. It would indeed be a calamity if competition should force some machine tool builders to meet no-profit operation of others by lowering their standards of workmanship, or to retard progress by their inability to expend a portion of their profits in new experimental machines.

From Manufacturers of Engine and Turret Lathes

We are in favor of keeping prices at their present point, although we would not, of course, hold out against a widespread movement on the part of other manufacturers to lower them. Perhaps our principal reason for doing this is that we have been hoping that wages could be maintained at their present level all along the line, even if that involved a permanently lower buying capacity for the dollar. The reduction of wages is liable to introduce serious social disturbances which should be avoided at almost any hazard. Keeping wages at their present point, in connection with the high price of commodities, would be of no real advantage to labor, but it will have a marked psychological value nevertheless.

If we can educate labor to see that the only hope for lower commodity values lies in increased efficiency, showing in a better quality and quantity of output, we can then register a net gain for the wage earner that will be a gain to society as a whole. For these reasons we hope there will be no wide spread movement to lower either the prices of machine tools or wages.

Machine tool manufacturers are still working on inventories which are the highest priced in the history of the business. Wages are also at the highest point. Neither manufacturers nor workers desire revision downward unless compelled by necessity. We think absence of demand in the machine tool market is due more to conditions of readjustment than to price schedule, therefore we are strongly of the opinion that the price schedule should remain as at present until we are farther along in readjustment period.

Prior to the first year of the European War, prices on machine tools were never high enough or consistently graded as compared with the profit of other manufacturers in metal working lines, and we have now no margin for reduction of prices with any consistent basis.

We do not believe that the trade will long continue in its attitude of waiting for a falling market, because those manufacturers whose business has been conducted along scientific lines, realize there is small margin for reduction in prices of machine tools until the elements entering into their manufacture, are themselves reduced.

We do not propose to reduce our prices until conditions justify our doing so. In other words, we will not arbitrarily cut our prices to stimulate business, for we do not believe that business is going to be greatly stimulated thereby.

Speaking in a broad sense and excluding those manufacturers who took advantage of the times and increased their prices all out of proportion to the real value of their machines, we would regard any agitation toward lower prices as unwise, until such time as it is known what the future is going to be in regard to costs and also how severe foreign competition will be. Possibly the exception to the above might be with those manufacturing machinery in which the proportion of raw material to labor was a substantial per cent, but on the average machine tool the cost of material is small as compared to the labor cost.

We believe a reasonable reduction in prices will stimulate business, provided the necessary confidence is created that further reductions will not be made; or, if they are made, will not operate to the disadvantage of the buyer.

We are not in favor of reducing prices at this time, but if competition demands it, 10% would be the maximum; and with it all agreements of every kind protecting the customer against further reduction should be withdrawn. Had the matter come up soon after the armistice was signed we would have looked upon it with more favor, for the reason that at that time we did not know that the shorter working week, without a substantial reduction in wages, was so near at hand, as events now seem to indicate.

From Manufacturers of Heavy Machine Tools

We are fundamentally in favor of a reduction in prices on all classes of machinery, including our own; but such reduction, we feel, is dependent upon a precedent being established by the producers of the materials which enter into the construction of machinery by giving the manufacturer an immediate reduction, or a fixed promise of a reduction at some comparatively early date.

Our attitude in favor of a reduction in prices of machinery is qualified to the extent that we are radically opposed to business in general being conducted at a price level below a normal or fair profit. We believe if the machinery manufacturers were to reduce their present prices below a reasonable profit to themselves it would be worse, ultimately, than if everyone "sits tight" and allows the situation to adjust itself from natural causes.

The local steel foundries have advised us that no material reduction will be made for the first six months of 1919. We, however, have received what we consider a fairly reasonable reduction in cast iron, but as we use such small quantities of cast iron in the construction of our machines in comparison with the steel castings, we cannot favor more than a 10% reduction in our prices under existing conditions.

We have not taken into consideration the labor cost question for we assume all are agreed that the price of labor in all probability will be maintained for a considerable period. We believe that labor must have its fair consideration and protection under existing high living costs.

I have never yet in my business experience been able to see any particular advantage in reviving trade by a big cut in prices, especially in the machine tool business, as we do not manufacture machines that are like ordinary commercial commodities purchased with a view of resale, where the buyer can store them, as it were, on the shelf and be able to sell them at a later date.

Our machines are practically all built to order, and, unless there is a case of replacement, it would be very difficult to induce a man to buy duplicate tools at any price if he had a lot of the same class of machinery idle in his works.

My opinion is that no reduction at the present time will stimulate business, but this opinion is only from our point of view. I know that it would not stimulate our business. What conditions are in the other machine tool lines, I could not say.

We could not make a reduction without having a corresponding reduction somewhere along our cost line. It would be a serious mistake to undertake at this time to ask labor to accept any reduction; not only a serious mistake, but it would be a wrong one. I do not see any chance of any material reduction in other costs.

There has been no reduction in cost to warrant a cut in prices. The labor cost on our product has not been reduced, and the reduction in material is not sufficient to warrant any cut in the selling price. Besides that, inquiries indicate the existence of a considerable volume of business which we expect will materialize in the form of orders within a few months. We do think, however, that the question of prices should be settled so that buyers will understand that they are not to pay a higher price if they buy now than they would pay if they held off for three or four months.

We have simply endeavored in our prices to provide for the rate of profit which we have heretofore secured under normally good conditions; but we have understood that some few manufacturers have not hesitated at any figure that they felt they could obtain, and they will no doubt feel obliged to meet the changing conditions. We do not believe, however, that a reduction in price would stimulate buying if there are few buying requirements, and this at present seems to be the case in our line.

We are making quotations as occasion arises, based on today's cost of production and covering, as nearly as we can estimate, a profit of about 10%. We do not believe that it is necessary to reduce prices to such an extent that it would result in a loss.

We have always maintained that a fixed price guaranteed for months ahead was unfair to manufacturer and customer alike, and have taken all war business on the basis of the price prevailing at time of delivery and always determined this price with relation to labor conditions and cost of materials at that time. We consider some present prices artificial, but do not believe they can be brought back to normal except by a period of dull business, as neither manufacturers nor labor are willing to make voluntary reductions.

Neither a small nor a large or radical reduction in price seems to fit the situation. The smaller—because it might just as well not be made at all; the latter—for the reason that it would demoralize the standing of industry, as many manufacturers know that before the war machine tools were sold at prices that were absurdly low, considering the amount of skill and investment required.

During the war, conditions have resulted in machine tools establishing themselves and it would be unfortunate if we should drift back to pre-war conditions.

There is every evidence of more business than can possibly be taken care of if confidence should be restored and business start up again. We have heard considerable comment on the throttle to enterprise that is being applied through the enormous taxation that manufacturers are called upon to meet. We have heard on numerous occasions the comment that there is not much incentive for manufacturers to take all the hazard of business and then have the government get the major portion of what is left without any thought or consideration being given to what would happen in the event of loss instead of profit.

We are receiving more inquiries than we can recall at any time in the past, yet the actual business that is being closed is such a small percentage of the inquiries as to be almost negligible.

We understand this general condition applies with many other manufacturers, indicating that there is an immense amount of potential business which could be let loose if the business men of America had confidence that everything was going ahead as it should.

What we feel may develop into a serious situation is the continued policy of postponing purchases everywhere until the momentum of business may lose itself in a general depression; consequently any steps that will restore confidence should receive every consideration whether through reasonable price reduction or through intelligently directed advices to Washington that would result in the Government giving business the encouragement and confidence it needs—not by mere assertions or wishes that good times are ahead, but by actual constructive policies which will convince the business men of this country that initiative and energy which they may put into their work will not be in vain.

Some Obvious Deductions

From the statements of manufacturers and dealers, and from facts with which the writer is familiar, these conclusions may be reached:

The large, and most of the smaller, well-known established machine tool manufacturers have not raised prices except when it was necessary to make a fair profit. Many of them could have obtained more than they did for their product during the war demand; but they considered it bad policy, their idea being to get a fair return rather than, as the head one of the leading concerns in the country, whose reputation is world-wide, expressed it, "to jump the peak and drop down suddenly." His opinion is that reductions do not stimulate machine tool purchases, for tools are bought when they are needed, rather than when they are offered as bargains.

The great majority of manufacturers, including all the largest except one, feel that there has been no reduction in costs warranting a general reduction in prices. All agree that manufacturers who have advanced prices excessively should reduce them to normal figures. All agree that there is no prospect of any material reduction in labor costs, and that it is not desired in view of present living costs. All do not agree that a price reduction will stimulate buying; most think it will not. The prices of materials have been slightly reduced, but not enough to warrant any considerable reduction on the finished products. The reduction in the cost of material, allowing for the reduction now in effect, varies from 4% to 8% on the cost of the tools, according to the proportion of raw material used. A reduction in cost is to some extent practicable on account of the increased efficiency of the workmen under present conditions; but that may be offset by the increase in overhead caused by reduced output.

The price reduction question is like an endless chain, and while it is true that price reductions must start somewhere,

it seems reasonable that they should start with what may be called fundamentals—that is, raw material, food and living expenses, rather than with finished product.

Labor costs and the prices of all products are established on high levels and we shall never see a return to pre-war prices. This should be considered carefully in making price adjustments, or they may be adjusted to levels that mean a loss which cannot be made up. It would be a great mistake to reduce wages under present conditions; a part of the manufacturer's profit must come from increased efficiency, and from the saving on wasteful methods that prevailed under war conditions.

The prevalent idea among those not acquainted with the facts is that all machine tool manufacturers made enormous profits during the war. Some did; but they are exceptions. As a class, machine tool manufacturers have not made as large profits as many others, such as powder manufacturers, munition manufacturers, or even farmers. When the armistice came suddenly, many had contracts cancelled, virtually without notice; and nearly all had stocks of material bought and partly finished machines produced at high prices. Many don't know yet what they have made, for they haven't got the money due them and don't know when they will.

There is an encouraging number of inquiries and a fairly good volume of business, especially in tools required for the manufacture of automobiles, trucks, tractors and agricultural machinery. But many buyers are apparently waiting to see what the price policy of manufacturers is to be.

A Disinterested Conclusion

The opinion of the writer, who has no interest to serve except that of the machine tool industry, is that excessively priced tools should be reduced to meet present conditions and that a reduction should be made on others to prices which will yield a fair living profit, allowing for recent reductions in material. But one essential to stabilized conditions is that manufacturers should decide what they intend to do, should make their decision generally known and should stand by it. There should be no legal objection now to an agreement on prices, for that principle has just received the sanction of the government, and if these can be established the danger of price-cutting will be averted. This may be called a readjustment rather than a reduction; but unless some such action is taken, individual manufacturers will continue to cut prices and buyers will hold off, waiting for such cuts, so that the general market may become demoralized. A heavy and general reduction in prices would resemble a surgical operation that was necessary to save a man's life. The machine tool industry is not in that extremity.

* * *

REDUCTIONS IN IRON AND STEEL PRICES

In the following are given the exact figures indicating the reductions agreed upon by the iron and steel trade. The prices are per net ton when not otherwise specified, and figures are given indicating the price on November 11 and the price when the present agreement went into effect.

Pig Iron (Long ton)—November 11, $33; reduced price, $25.75; total reduction, $7.25; reduction in per cent, 22.

Sheet Bars (Long ton)—November 11, $51; reduced price, $42; total reduction, $9; reduction in per cent, 20.

Merchant Bars—November 11, $58; reduced price, $47; total reduction, $11; reduction in per cent, 19.

Sheared Plates—November 11, $65; reduced price, $53; total reduction, $12; reduction in per cent, 18.

Structural Steel—November 11, $60; reduced price, $49; total reduction, $11; reduction in per cent, 18.

Wire Rod (Long ton)—November 11, $57; reduced price, $52; total reduction, $5; reduction in per cent, 9.

Plain Wire—November 11, $65; reduced price, $60; total reduction, $5; reduction in per cent, 8.

Light Rails—November 11, $60; reduced price, $49; total reduction, $11; reduction in per cent, 18.

Bessemer Rails (Long ton)—November 11, $55; reduced price, $45; total reduction, $10; reduction in per cent, 18.

H-rails (Long ton)—November 11, $57; reduced price, $47; total reduction, $10; reduction in per cent, 18.

WAR DEPARTMENT ON LENDING MACHINE TOOLS TO SCHOOLS

With regard to the bill introduced into Congress to authorize the lending to technical schools and universities of the machine tools now in the hands of the Government, but of no further present use, the War Department has made the following statement: "While there is every desire to assist these institutions, the department, after a thorough study of the situation, cannot approve the legislation in its present form. It is not believed that a loan of the tools can be acceptable either to the Government or to the borrowers. There can be no certainty as to the length of time for which the borrowers may hold the tools, and any school or university would hesitate to make preparation in the way of expensive laboratories or shops in which to place the tools, when they could not be sure of holding them. The distribution of tools in this manner would be exceedingly expensive to the Government: first, in the organization necessary to lend the tools in an intelligent manner; second, in the maintaining of an inspection service to protect the interests of the Government inasmuch as the tools would still remain the property of the Government, and the War Department would be responsible for them. Should Congress decide to act in the matter, it is believed that a preferable solution of the problem would be to authorize the War Department to sell these machines at 10 per cent of their cost value, the proceeds of the sale to go toward paying the expenses of the sale. In this manner, the schools would receive absolute title to the tools and machines at a nominal price, and the expense to the Government would be practically limited to the value of the tools."

* * *

GAGE TESTING CONDUCTED BY BUREAU OF STANDARDS

The Division of Weights and Measures has for several years tested and standardized precision length standards and various forms of gages and measuring instruments for the several branches of the Federal Government and for industrial concerns. In keeping with the program for the rapid production of munitions, this work was expanded to a large degree in order to provide for the many demands made by the War and Navy Departments and by manufacturers having contracts for war material. On June 15, 1917, a special war appropriation of $150,000 for the gage work of the Bureau of Standards was granted by Congress, and on July 8, 1917, apparatus and equipment were transferred to a special temporary building for the testing of munitions gages. Apparatus and personnel for testing gages were assembled at an early date to enable this bureau to test without delay such gages as might be submitted. The first lot of munitions gages was submitted on July 16, 1917. Practically all of the various lots of gages have been completed and shipped within three or four days from the time of receipt. In many instances the gages were received, tested, and shipped on the same day.

The organization of the gage section includes a shop which was arranged primarily for the construction of special apparatus required in the rapid and accurate testing of the more complicated forms of gages, for example, thread gages and profile gages. The personnel of this shop being mainly toolmakers and gage-makers, it has been of service in the salvage and making of gages for urgent needs. The gage section also has prepared and distributed technical information pertaining to the methods of tests, tolerances, tables for computations, and other essential data for the use of gagemakers and gage inspectors. Blueprints and specifications of special machines designed by this bureau for measuring gages have also been distributed to manufacturers. The gage section of the Bureau of Standards performs so important a function that it is to be hoped that Congress will provide ample means for continuing this work.

Developing Export Trade to Russia

Based on an Interview with R. Martens, Vice-president of R. Martens & Co., Inc., New York City

MANY optimistic forecasts have been made in regard to the probable demand for products of American manufacturing plants which will be needed for use in the reconstruction of war-torn Europe. It would seem, however, that this optimism is one of those cases in which the hope is father of the thought. Actually there was little ground for expecting that the termination of hostilities would once more bring a flood of foreign orders to American manufacturers. It is only necessary to briefly consider the effect of war-time conditions upon the manufacturing capacity of Great Britain, France, Italy, and other nations which have been devoting their entire energies to the prosecution of the war for a period exceeding four years. Great numbers of factories have been built and equipped for the manufacture of various types of munitions, and now that the war is over, other uses must be found for this increased plant capacity. Reconstruction work offers one of the more obvious means of keeping these new factories busy, and of providing employment for the large numbers of men and women who have received intensive courses of training so that they might be able to give efficient service in the manufacture of munitions and various other war equipment. In order to protect the product of these plants from the competition of foreign manufactured goods, it appears certain that protective tariffs will be imposed.

R. Martens, from whom the information presented in this article was obtained, is the head of R. Martens & Co., Inc., 6 Hanover St., New York City. This firm specializes in Russian export trade, and in addition to its offices in the United States maintains establishments in France and Great Britain, and in the leading commercial centers of European Russia and Siberia. At the end of April, Mr. Martens expects to go to Siberia in order to personally direct the establishment of his firm's selling organization in that country, and to institute the educational propaganda to which reference is made in the article. American machine tool builders and manufacturers of small tools who would like to avail themselves of this opportunity of establishing a market for their products in Russia and Siberia will find Mr. Martens prepared to give them advice, based upon an accurate knowledge of merchandizing methods in those countries in which his firm operates.

Possibilities of the Russian Market

In Russia, the position is vastly different from that of all the other belligerent nations of Europe, with the possible exception of Belgium. Instead of having the number of manufacturing plants within her domain greatly increased by war-time conditions, the last four years have witnessed a decrease in the number of Russian factories and a great deterioration in the condition of equipment in all remaining plants. The reasons are not difficult to find. With an idea of preventing machinery from falling into the hands of German armies which advanced into northwestern Russia, the equipment of many factories in this section was taken to cities located farther from the German border, but in making this transfer, it was inevitable that many parts would be damaged and, in numerous cases, replacement has been impossible, owing to the fact that the original machines were built in Germany. Furthermore, during the first year of the war, a great many Russian manufacturing plants were built in the vicinity of the German frontier, with the result that the invasion which took place during that period resulted in the complete demoralization of these new industrial developments.

There is little in the way of a machine-building industry in Russia, and when blueprints (furnished by the Germans at the time the machines were shipped) were sent to England or elsewhere to have replacement parts made, it was found that the prints were doubtless keyed by the machine builder so that they represented the dimensions required to make the part interchangeable plus or minus some specified amount—say two millimeters. In any case, this condition has prevented the restoration of many damaged machines, and the condition of those that are still running has greatly deteriorated, due to the scarcity of lubricating oil and the difficulty experienced by the heads of Russian manufacturing plants in handling their problems of maintenance. In addition to these important factors, there has been a great amount of the equipment of Russian industrial plants actually destroyed, during recent revolutions and on account of the removal of brass bearings and other metal parts of machinery required for the manufacture of munitions.

Unfortunately, it is a matter of only too general knowledge that the economic conditions in Russia are, at present, absolutely chaotic; but those who are best informed in regard to the Russian situation are predicting that the reign of terror created by the Bolsheviki will soon have run its course. The men who are fathering this anarchistic movement lack the experience which would be absolutely essential to enable them to long maintain a hold upon the reins of government; and a careful scrutiny of the lists of those who have joined the ranks of the revolutionists fails to reveal any man of the required caliber to carry the movement to a successful conclusion. Assuming that order will soon be restored and the country placed under a stable democratic government, it seems fair to assume that Russia will enjoy a degree of prosperity greater than she has ever known. There will be greater opportunity to develop the unbounded natural resources of the country; and this industrial development will make it necessary to purchase manufacturing plant equipment. During the period in which such purchases are being made, there should be a great opportunity for American machinery builders to develop foreign markets.

Buying Power of Russia

The question is naturally asked by American manufacturers who are considering the possibilities of export trade to Russia: "How will such purchases be paid for?" The answer is: "With credits established through the sale of foodstuffs, flax, mineral products, and lumber." The proceeds of the sale of the first of these commodities will doubtless be the more important factor, because, while the costs of all other products, including labor, are likely to undergo a substantial shrinkage in the next year or two, it seems fairly certain that there will still be a food shortage at the end of this period which will hold the cost of food at a high level. At present, the paralysis of transportation and distributing facilities in Russia has created a condition of famine in many sections, but when order is again restored, the food-producing capacity of the country should return to at least the level which existed prior to the outbreak of war in 1914. At that time, Russia was able to export 35 per cent of her total food products, and with the high prices of these commodities which are likely to prevail, such exports will build up credits in favor of Russia which should give the country ample funds to pay for equipment needed to carry on a considerable expansion of industrial activities.

Classes of Russian Buyers for Machine Tools

There are two general classes of Russian customers for American machine tools and factory equipments. These are, first, the large manufacturing corporation which will occasionally place orders for large numbers of machines; and, second, the small company, or the individual, who will seldom buy more than one or two machines at a time. The methods which must be followed in making sales to these two classes of customers are just as different as the kind of business which may be obtained from them.

In the case of the large corporation which is developing an industrial enterprise requiring a large investment in mechanical equipment for a manufacturing plant, engineers and technical experts will be employed to search the markets of the world to find the exact types of machinery and tools which are best adapted for the peculiar requirements of the work on which they are to be used. Such customers do not require the same amount of "cultivation" from the salesman as the owner of a small shop who has poorer facilities for learning of different types of machines, and so is likely to take the first one that appears to give the required service.

In Russia and Siberia, there are a great number of small shops that are comparable to an American blacksmith shop as regards the position which they hold in the economic structure of the country. These shops are called upon to do a general line of jobbing work which consists chiefly of making or repairing crude forms of agricultural implements, tools used in the lumbering industries, etc. Those who have made a careful study of conditions in the more remote sections of Russia state that the methods used by the peasants are extremely crude; but the Russian peasant, although he is as a rule very poorly educated, has, in most cases, a remarkable mental capacity.

How to Develop Russian Trade

American manufacturers who hope to develop a profitable export trade to Russia must not be contented to wait for the orders from occasional buyers which come to them unsolicited. A progressive educational campaign is required, and probably this can be done to best advantage through the services of an agent who already has an established sales organization in Russia. R. Martens & Co., New York, is, at present, working upon the development of an educational campaign which has many points to commend it. The scheme is to establish eight stations in representative industrial centers of Siberia. These will be located in districts where mining, lumbering, etc., are the chief business of the local population, and in each station there will be an exhibition of American machinery used in the local industry.

In addition to this demonstration station, there will be maintained a complete file of catalogues of American manufacturers engaged in building equipment for the local industry, and a moving picture exhibition, showing the way in which the same industry is practiced in the United States. The films made for this purpose will be prepared to show American machinery and methods, but the work will be done by men dressed in Russian costume. The idea is that the Russian peasant will see a man, clad in garments with which he is familiar, engaged upon the performance of a familiar task, but showing improved machinery, tools, and methods. Mention has already been made of the fact that the uneducated Russians are quick to learn, and it is believed that the sight of men dressed like themselves will hold their interest and enable them to grasp the message carried by the film; namely, that there is no reason why they cannot use these improved machines and methods to lighten their labor.

Before the war, Russian peasants bought most of their tools from German middlemen doing business in Russia. It is a well-known fact that the more poorly educated men are likely to be ultra-conservative about adopting new methods, and some doubt has been expressed as to the possibility of persuading uneducated Russians to purchase machinery and tools of somewhat different design from those with which they have become familiar through the educational work conducted by German salesmen. However, for over four years, the manufacturers of Germany have not been in a position to supply the Russian market with tools, and it is fair to assume that the urgency of the present demand affords an exceptional opportunity for the introduction of American manufactured products into the Russian market. The decision of R. Martens & Co. to establish demonstration stations in which American machinery and tools will be exhibited during the winter, when the peasant is unemployed, has been reached by reason of the fact that many men will then come to these centers from outlying villages; and in the spring they will go back with a knowledge of American machines and methods which will naturally lead to the purchase of such equipment.

Siberia was selected as the field of operations for three reasons: First, the Siberian population is composed chiefly of emigrants from Russia, and they have for many years been land-owners in their own right. Naturally, they are not inclined to be pro-Bolshevik. Second, the enormous influx of refugees from Russia, who are sick of the Bolshevik regime, is creating a new community thought. Third, the United States Government has now taken charge of the reconstruction of the Trans-Siberian Railway, which is the first step toward establishing a sound economic system in Siberia as well as in European Russia; and it is probable that Siberia will experience less difficulty in coming back to a normal condition than did European Russia. Later, when European Russia has established a stable form of government, it is planned to conduct the same campaign there.

Types of Machine Tools to Sell in Russia

In preparing for a sales campaign in Russia, the manufacturer who is going after a large volume of business from the many small potential customers, rather than a few large orders from corporations, should bear in mind that the men to whom he is endeavoring to sell his product have little or no knowledge of mechanical work as it is done in America. Consequently, a point should be made of recommending the simplest types of machinery and tools; and, in some cases. it would be advantageous to make a practice of simplifying designs which are regarded as standard for machines sold in the United States. As regards the types of machines for which there is most likely to be a demand, those who have studied conditions state that for the local jobbing machine shops the chief call will be for drilling machines of either the upright or post radial types, for simple engine lathes, shapers, and small-sized planers, and possibly for some plain milling machines. In addition, there is undoubtedly a market for combination woodworking machines.

General Summary

The possibilities of exporting to Russia may be summarized as follows: The larger buyers who have a very complete engineering service at their disposal are more likely to send unsolicited orders to the manufacturers of this country than are the small buyers; but there are many thousands of small buyers to each firm which is likely to place single orders for large quantities of machinery. Bearing these facts in mind, it would seem that the manufacturer would be wiser to institute educational campaigns with the idea of obtaining many small orders than to devote his time to an effort to obtain a few large orders. Orders from small shop proprietors who are, in many cases, quite unfamiliar with the features of American machinery and tools, can be secured only as a result of an aggressive educational selling campaign. It is essential for the salesman of engineering equipment in Russia to have a competent knowledge of the language. An interpreter will often fail to put the arguments of the salesman into technical terms which will properly convey the meaning. Unless a salesman possessing the required qualifications can be obtained, the manufacturer should make selling arrangements with a Russian export house.

Cylinder Grinding

Second of Two Articles on Advantages of Finishing Cylinder Bores by Grinding; Machines Used; and Practice in Plants Making Automobile and Airplane Engines

BY FRANKLIN D. JONES

THE first article on this subject, in the March number, discussed the relative advantages of finishing cylinder bores by grinding and by reaming, and gave opinions of representative automobile manufacturers as to the preferable method. The practice employed in grinding the cylinder bores of airplane and automobile engines, and the machines and equipment used, were described. The present article concludes the description of the methods and machines used for this class of work.

Examples of Cylinder Grinding in Automobile Plants

The cylinder bores of engines for the more expensive cars are almost invariably finished by grinding. While there is no definite dividing line, as a general rule if the selling price of a car is more than a thousand dollars, it usually has ground cylinders, whereas if the price is less than the sum mentioned, the reaming method (possibly followed by a lapping operation) is more generally employed than grinding. This is due to the fact that a cylinder can be reamed much more quickly than it can be ground, as far as the actual machining time is concerned. A few examples of cylinder grinding, taken from different automobile plants, will be referred to in order to illustrate some of the variations in practice.

One of the cylinder grinding machines used by the White Co., Cleveland, Ohio, is illustrated in Fig. 13. This view shows a four-en-bloc cylinder after the grinding operation. The cylinders are first bored and then reamed on a vertical multiple-spindle machine to within 0.008 or 0.010 inch of the finished size. Before the grinding operation, the cylinder castings are heated to a temperature of 500 degrees F. for a period of four hours in order to relieve the internal stresses and prevent them from being distorted by the heat generated when the motor is in operation. The fixture for holding the cylinder while grinding is provided with two dowel-pins at *A* and *B* which govern the location of the cylinder. These dowel-pins are in the same relative positions and enter the same holes as the dowel-pins of the boring and reaming fixtures previously used. During the grinding operation no water is circulated through the jacket or over the outside of the cylinder, as this is not considered necessary. The practice is to rough-grind each bore and then take a light finishing cut. If the bore to the extreme right is the first one to be rough-ground, the finishing cut in this bore is not taken until the other three bores have been rough-ground; consequently, each cylinder bore is allowed to cool after the rough-grinding operation and before taking the finishing cut. The wheel-head of this machine revolves about 80 revolutions per minute, which represents the rate at which the wheel traverses around the cylinder wall, and should not be confused with the speed of the spindle, which, of course, revolves very rapidly. The cylinder grinding machine shown in this illustration was formerly made by the Brown & Sharpe Mfg. Co., but is now manufactured by Baxter D. Whitney & Son, Winchendon, Mass.

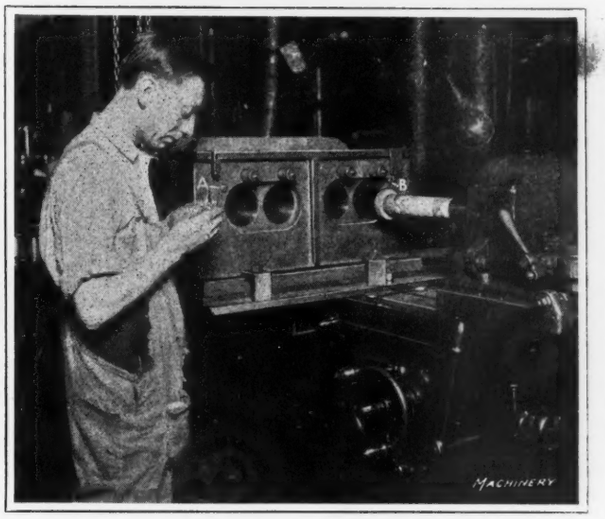


Fig. 13. Cylinder Grinding Operation at the Plant of the White Co.

A cylinder grinding operation at the plant of the Cadillac Motor Car Co. is illustrated in Fig. 14. This particular illustration shows the grinding of four-en-bloc cylinders having the heads cast solid. The present design of cylinder has a removable head, although the grinding operation is the same in each case. The cylinders are reamed to within approximately 0.010 inch of size before grinding. This is another example of cylinder grinding without the use of circulating water in the jacket. The cylinders are ground to within 0.002 or 0.003 inch of the finished size, and are then allowed to cool before taking the light finishing cuts. The lower part of the cylinder has a length of about 3¾ inches which is not surrounded by a jacket; therefore, if water were used in the jacket, it would be necessary to cool the unjacketed end by pouring water over the outside, and in order to avoid this, the method previously referred to is followed; that is, the heat generated by the roughing cut is allowed to dissipate before taking the finishing cut. The cylinder bores are ground to 3.125 inches, usually within a limit of about 0.001 inch, although a tolerance of 0.002 inch is allowed. The wheel-head makes 80 revolutions per minute, and the feeding movement of the wheel through the cylinder bore is at the rate of about 6½ inches per minute for both the roughing and finishing cuts. This feeding movement is equivalent to approximately 3/32 inch per revolution of the wheel-head. About 0.002 or 0.003 inch of stock is removed by each roughing cut; usually two in-and-out traversing movements, or four cuts through the cylinder bore, are required for roughing, and about the same number of very light cuts for finishing. The pipe for exhausting the dust caused by grinding and for cooling the cylinder may be seen in the illustration at the head end of the cylinder. It will be noted that this pipe is inserted opposite whichever bore is being ground.

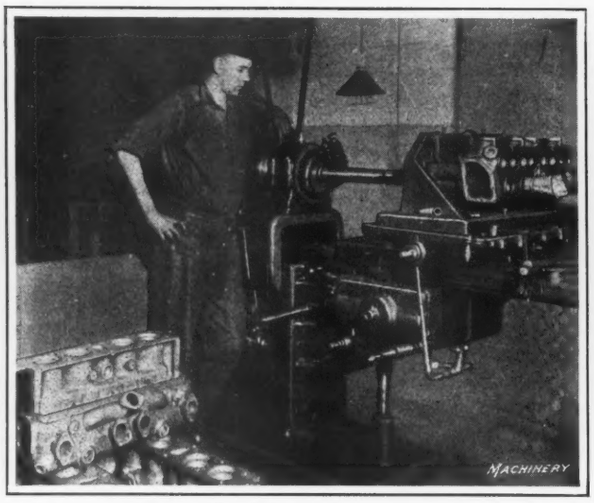


Fig. 14. Grinding Cadillac Four-en-bloc Cylinders (Example of Grinding without the Use of Circulating Water)

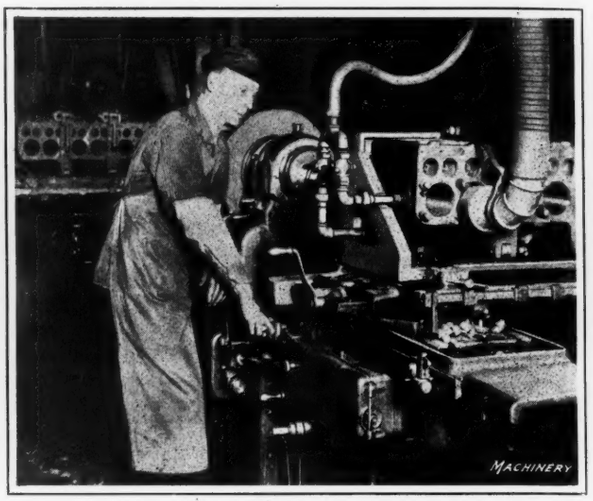


Fig. 15. Cylinder Grinder equipped with Dust Exhauster and Pipes for circulating Water through Jacket and over Unjacketed End

The practice of the Hudson Motor Car Co. in machining cylinder bores is to make the bores as accurate as practicable before attempting to grind them, thus reducing grinding time to a minimum. Three cuts are taken through the bore prior to grinding. First, there is a heavy roughing cut, and then a lighter roughing cut, followed by a reaming operation which enlarges the bore to about 3.496 inches before grinding to 3.500 inches. The allowance for grinding, therefore, is only 0.004 or 0.005 inch, subject, of course, to slight variations. It has been found more economical to machine the cylinders close to the finished size than to be less careful with the boring and reaming operation and remove a larger amount of stock by grinding. Usually, about four traversing movements of the wheel through the bore are required for the grinding operation. Fig. 15 shows the machine grinding the second bore from the left, as indicated by the position of the dust exhaust pipe which leads to the main exhaust line above. The cylinder is water-cooled during the grinding operation. There are two pipes for supplying the cooling water, as shown in the illustration. One of these pipes leads to the cylinder jacket, and the other extends beneath the casting and is perforated in order to spray water over the unjacketed end of the cylinder. It is claimed that these cylinders are ground within a limit of 0.001 inch on the diameter, and accurate as to taper or roundness within 0.0005 inch.

The Heald cylinder grinding machine illustrated in Fig. 16 is arranged for grinding the holes in the sleeves of Knight engines. These sleeves have an inside diameter of 4.250 inches, an outside diameter of 4.6923 inches, and they are 13.125 inches long. The hole is said to be ground and held within limits of 0.0005 inch, and one machine has an output of fifty sleeves for a ten-hour working day. The sleeve is held in a special water-cooled fixture. The water enters through the two connections seen at the top, and circulates around the outside of the sleeve. This illustration is from the plant of F. B. Stearns Co., Cleveland, Ohio.

The automobile cylinder grinder illustrated in Fig. 17 is in use in the Packard plant. This view shows the grinding of a six-en-bloc cylinder casting. Just above each bore on the fixture there is a holder for the diamond wheel-truing tool.

Grinding Cylinders of Stationary Gas Engines and Fire-engine Motors

At the plant of John Lauson Mfg. Co., New Holstein, Wis., cylinders of rather large size are finished by grinding. These cylinders are for stationary gas engines, and they are from 4 inches in diameter up to 7¼ inches. Fig. 18 shows one of the larger cylinders being ground. The allowance for grinding on the smaller sizes varies from 0.008 to 0.010 inch, and on the larger sizes from 0.017 to 0.020 inch. The limit of accuracy is 0.00025 inch, plus or minus. Four-inch cylinders for 4- by 5-inch engines are ground at the rate of sixteen per day of ten hours, and the 7¼ inch size for 7¼- by 10-inch engines are ground at the rate of ten per day of ten hours. While more time is required to finish the cylinders by the grinding method than by using some form of cutting tool, the new engines operate more economically, as better compression is obtained, especially when the engines are first put into service.

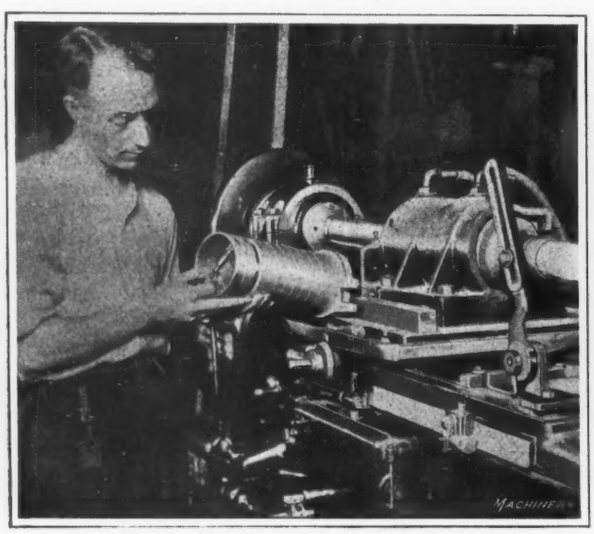


Fig. 16. Grinding the Sleeves of Knight Motors

Fig. 17. Grinding a Six-en-bloc Casting

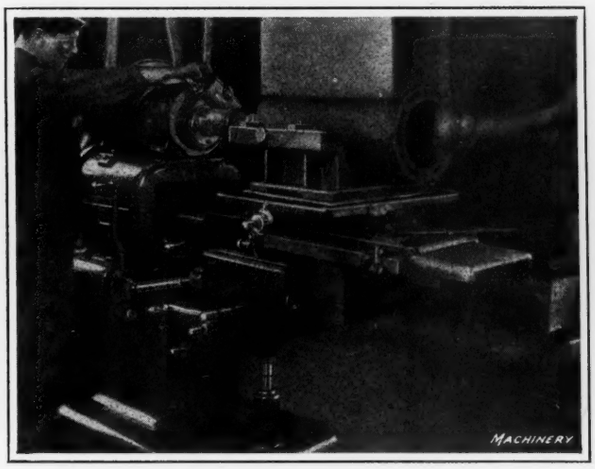


Fig. 18. Grinding a Stationary Gas Engine Cylinder

Fig. 19. Grinding Cylinder for Fire-engine Motor

The grinding of cylinders for fire-engine motors is illustrated in Fig. 19. These two-en-bloc cylinder castings are for 90-horsepower motors. The bore is 6¼ inches in diameter, and the length of the cylinder is 14 inches. Ten cylinders, or twenty holes, are ground per day of ten hours, and the work is held to a limit of 0.0005 inch.

Fixtures for Holding Cylinders while Grinding

The fixtures used for holding cylinders during the grinding operation are usually in the form of an angle-plate. The vertical surface of the angle-plate is set perpendicular to the axis of the grinding machine spindle, or to the line of the traversing movement, and the finished face of the cylinder casting is clamped in some way against this vertical surface. A type of fixture which has been extensively used is illustrated in Fig. 20. This is one of the Heald Machine Co.'s designs. The cylinder is clamped against the vertical faceplate by a bar clamp extending across the end, as the illustration shows. This bar clamp is pivoted at the lower end so that it may be readily swung out of the way, and the upper end is slotted to receive a second bar to which an eccentric clamping lever or handle is pivoted. While this fixture has spring pins located beneath the casting near each end, these are not needed, as the clamp holds the cylinder securely.

Two plugs may be used to locate the cylinder in horizontal and vertical directions, although this is not the general practice. One plug is engaged with each end hole or bore, and rests upon the lower edge of the rectangular opening or slot in the faceplate when the cylinder is in position. The cylinder is then shifted until the plug at the left-hand end bears against the end of the slot, after which the work is clamped in position for grinding and the plugs are removed. Cylinders having a neck or extension on the flange end may be located by the finished surface of this extension.

Cylinder grinding fixtures are usually provided with dowel-pins which engage holes previously drilled and reamed in the flange or crankcase end. All of the fixtures which may be used for boring, reaming, and grinding are provided with dowel-pins located in corresponding positions. Two holes are usually employed for locating purposes, and the dowel-pins on each different fixture that may be used engage these same holes.

The special design of fixture shown in Fig. 21 is for holding the sleeves of Knight motors while grinding them internally. This fixture is practically the same type as the one shown in Fig. 16. It is surrounded by a water jacket connecting with the two pipes shown. The water is not allowed to flow into the inside of the sleeve, but is simply circulated around it, in order to prevent the sleeve from being overheated and distorted during the grinding operation. The sleeve is held in place by a swinging end clamp which is pivoted at the base of the fixture, and is tightened against the work by the small thumb-screw seen at the top.

Special Fixture for Airplane Engine Cylinders

The fixtures for holding an airplane engine cylinder must be carefully designed to prevent any distortion of the cylinder as the result of improper clamping or excessive clamping pressure. Fig. 22 shows a fixture designed by the Heald Machine Co. for Liberty motor cylinders. The cylinder which is shown in the fixture at the left, is a steel forging having very thin walls. The cylinder is surrounded by a sheet-metal water jacket which is welded to it by the oxy-acetylene process. Not far from the open end of the cylinder there is an external flange which is clamped against the vertical faceplate of the fixture. This faceplate is bored out to receive the open end, and the cylinder is held in position by applying the clamping pressure at the head end. The clamping member consists of a loose fitting collar mounted on a

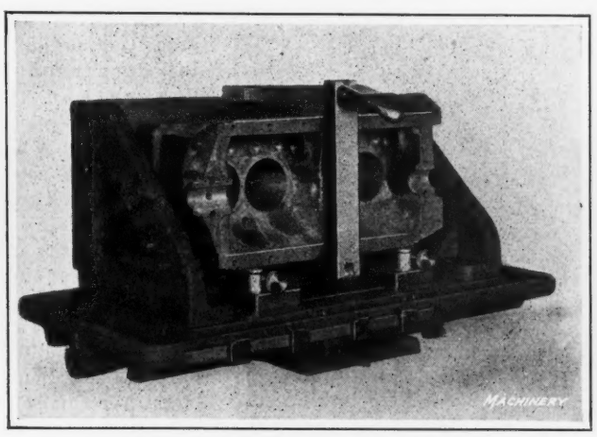


Fig. 20. Fixture for holding Cylinders while grinding

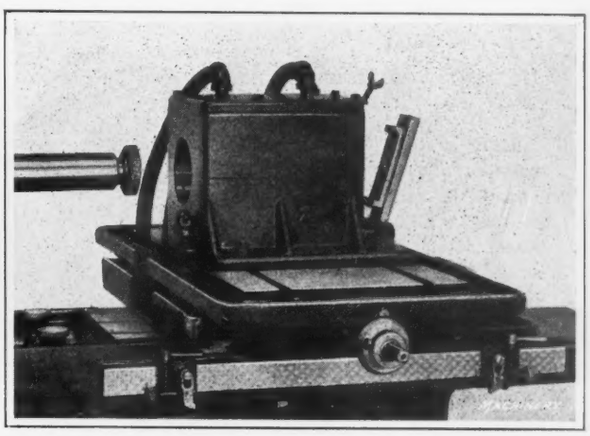


Fig. 21. Fixture for holding Sleeves of Knight Motors

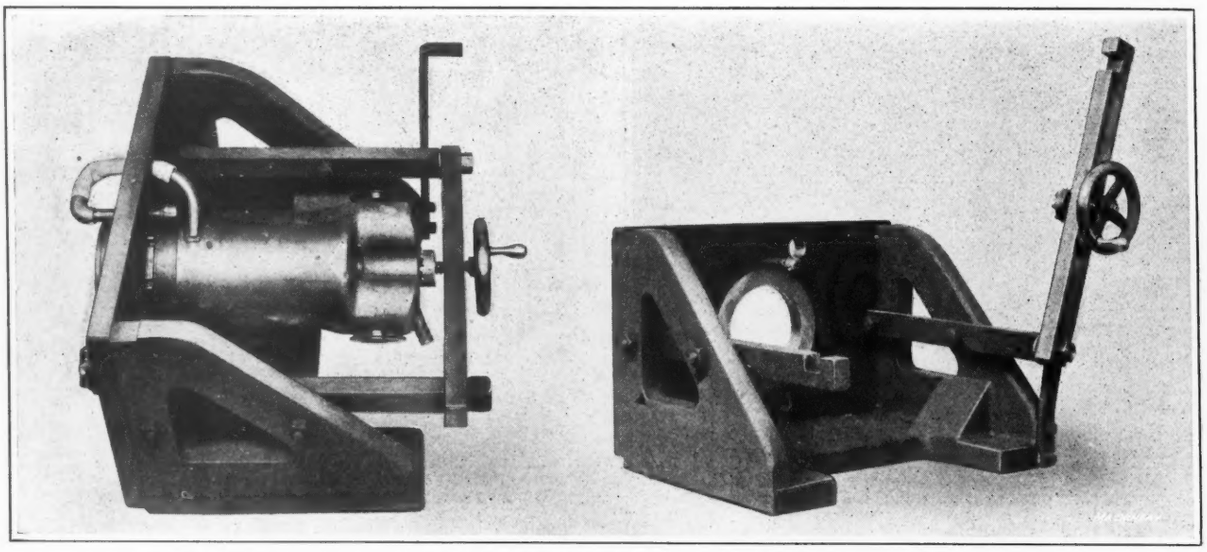


Fig. 22. Special Fixture for holding Airplane Engine Cylinders

screw, to which a handwheel is attached. This screw passes through a bar which may be swung back out of the way (see right-hand view) for inserting or removing the cylinder. Water is circulated through the jacket while grinding, entering at the head end and leaving at the opposite end of the jacket. The unjacketed section, adjacent to the open end of the cylinder, is flooded on the outside by a short length of perforated pipe which may be seen projecting through the faceplate of the fixture. This method of cooling has proved very effective.

Cylinder Grinding Attachment

In repair shops where a comparatively small number of cylinders may require grinding and the expense of a special cylinder grinding machine would not be warranted, some type of grinding attachment may be used. One attachment of this kind, intended for application to engine lathes, is illustrated in Fig. 23. The wheel-spindle is mounted eccentrically relative to the lathe spindle, and it traverses around the cylinder wall slowly while revolving rapidly about its own axis, the action being similar to that of a regular cylinder grinder. The wheel-spindle is driven by the belt seen at the left-hand end of the headstock, which connects with an independent countershaft and revolves a driving shaft extending through the hollow lathe spindle. This shaft, which is mounted in bronze bearings, transmits motion to the grinding-wheel spindle through a pair of universal joints. The grinding-wheel spindle is carried by a plate which is bolted to the lathe faceplate and has an elongated slot on one side so that the wheel-spindle may be offset relative to the lathe spindle. This eccentric adjustment is made possible by the universal joints referred to. When a cylinder is being ground, the backgearing of the lathe is engaged so that the planetary motion, or rotation of the wheel-head, is relatively slow, while the wheel itself revolves at a peripheral speed varying from about 4500 to 5000 feet per minute. The cylinder is clamped against an angle-plate, as the illustration shows, which, in turn, is bolted to the lathe carriage. The steel tubing carrying the wheel is held in an adjustable plate by two clamping bolts. By loosening these bolts and removing one pin in the universal joints, the tube and the wheel may be withdrawn and a boring-bar substituted, in case the amount of stock to be removed is sufficient to warrant taking a boring cut prior to grinding. This attachment is made by the Salter Motor Mfg. Co., 1516 Oakland Ave., Kansas City, Mo.

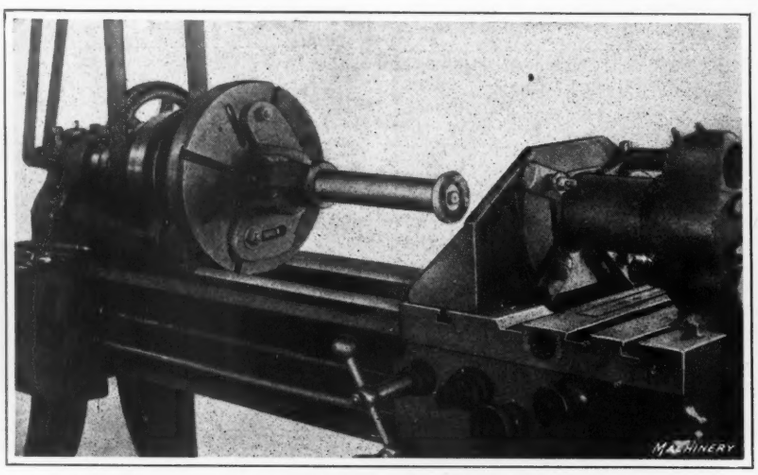


Fig. 23. Engine Lathe equipped with Salter Cylinder Grinding Attachment

Wheels to Use for Cylinder Grinding

The quality of work and the rate of production may both be seriously affected if the grinding wheel is not suitable. The selection of grinding wheels varies somewhat according to the ideas of different engine manufacturers as to the finish required for cylinder bores. A fine light finish is not necessarily an indication of accuracy. A coarser and freer cutting wheel may not leave quite as much polish in the bore as a harder finer wheel, but the chances are that the work is more accurate. Then too, a free-cutting wheel grinds faster, which is an essential feature. In general, the wheel should be as soft as it can be without crumbling or wearing away too rapidly under reasonably heavy cuts. Too much attention is often paid to wheel wear. The extra cut for fairly soft wheels may be very small as compared with the increase in the production of ground cylinders made possible by the use of such wheels. In other words, while the wheel wears faster than one of hard bond, it also cuts faster and does more work. Although a wheel of very hard bond would last a long time, its rate of production would also be very low. Ordinarily the wheel should not be harder than grade K according to the Norton system of grading or grade O according to the Carborundum Co.'s method. The grain usually varies from 36 to 60. A fine wheel is not necessary to obtain a good finish if the wheel face is kept true and the relative speeds and feeds are suitable. Wheels that are too hard and fine represent a much larger percentage of the mistakes in wheel selection than those

which are too soft and coarse. The exact grade and grain should be determined by actual trial, because of varying conditions. The harder and more dense the cutting, the softer the wheel should be. A relatively soft wheel is also preferable when a liberal allowance has been left for grinding, or when grinding a cylinder having thin walls which are easily distorted by the boring operation. In grinding cylinders for two-cycle engines having open ports on the side, the bond of the wheel should be harder than for a plain cylinder, because the edges of the port tend to tear out the abrasive. The grade of wheel to use may depend somewhat upon the design of the machine or its condition. For instance, a soft free-cutting wheel, suitable for a rigid machine without play in the grinding spindle or looseness in other working parts, might be too soft for a machine which vibrates considerably. The vibration causes the abrasive grains to be dislodged more rapidly, and if it cannot be eliminated by the adjustment of bearings or slides and is due to the lightness of the parts, the remedy is to use either a harder wheel or a different machine. Wheels made from abrasives belonging to the carbide of silicon group—such as carborundum and crystolon—should be used for grinding cast-iron cylinders, but for grinding steel airplane cylinders an aluminum-oxide abrasive such as alundum or aloxite is preferable.

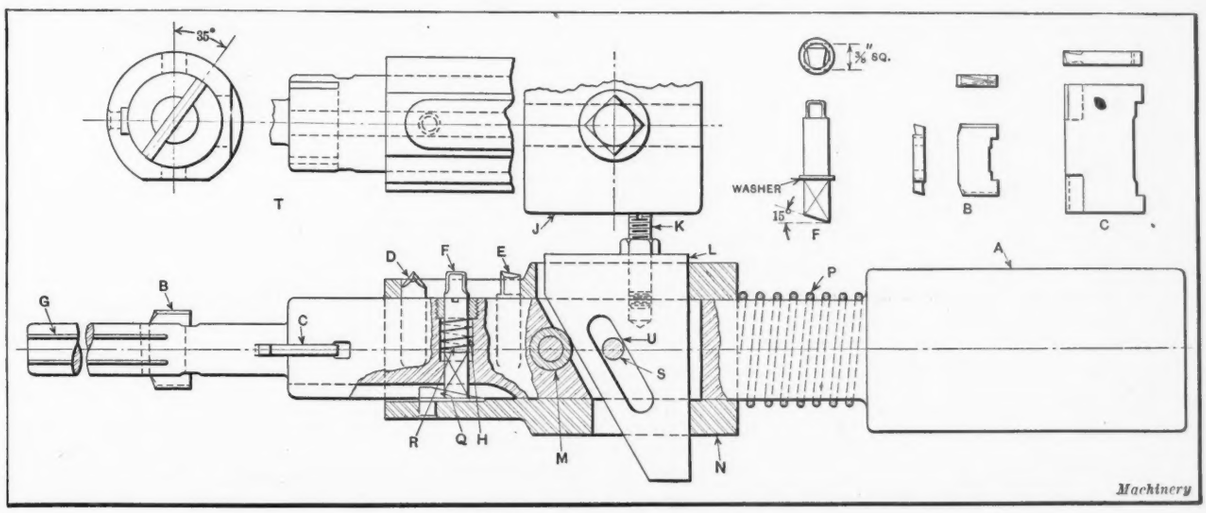
* * *

COMBINATION BORING AND RECESSING BAR FOR TURRET LATHE WORK

The special boring-bar shown in the accompanying illustration, has in addition to the regular cutters, a recessing cutter and special operating arrangement for use in connection with it. As will be seen, it is intended for turret lathe work, the bar being held in the turret by the shank *A*. The flat cutters *B* and *C* and the pin cutters *D* and *E* are of the ordinary type and need no description. The special feature of the bar to which attention should be called is the method of operating the recessing tool *F*.

It should be noted that the various cutters are so arranged radially as to equalize the working strain; that is, the cutters *B*, *D*, and *E* are at right angles to the recessing tool *F*, and the tool *C* is set at still another angle, as shown in the partial end view *T*. The bar is guided into the work by means of the pilot *G*, and while the other cutters are performing their respective functions, the recessing cutter *F* is held beneath the outside surface of the sleeve *N* in which the bar operates. By referring to the illustration, it will be noted that this cutter has a beveled end of square section and that it is prevented from turning in the bar by being set into a square hole. This hole is counterbored to provide space for a compression coil spring which fits over the cutter and bears against the collar or washer *R*; being confined by a special screw, its action against the collar causes the cutter to be held below the surface, as stated. After the bar has been fed into the work to the proper distance for recessing, the cross-slide is fed forward toward the center of the machine until the block *J*, which is carried on the slide, comes into contact with the adjusting stop-screw *K* in the wedge *L*. The continued advance of the cross-slide causes the wedge to slide on the roller *M*, both the wedge and the roller being carried in the bar. A slot is provided in the bar in which the wedge slides, the length of this movement being confined by the length of the slot *U* in the wedge and the pin *S*, which is driven into the bar and passes through the slot in the wedge, as will be seen by reference to the illustration.

The sleeve *N* covers this entire arrangement, and is slotted to accommodate the projecting ends of the wedge. The action of spring *P* keeps the sleeve and wedge in contact, within the slot, so that the movement of the wedge, as previously explained, will cause sleeve *N* to recede, compressing the spring. As the sleeve recedes the angular surface of the special key *Q* is brought into contact with the beveled end of the cutter *F*. This key is secured by means of a boss which fits into a hole in the sleeve *N*, the angular section fitting into a keyway in the bar itself. The contact of the angular surfaces of the cutter *F* and of the key *Q* causes the recessing tool to be fed into the work to the required depth. When this depth has been attained the cross-slide may be caused to dwell while the bar is fed farther into the work and the recess cut to the desired length, the end of the adjusting screw *K*, meanwhile, sliding along the block *J*. As soon as the slide allows the block to be removed from contact with the stop-screw, spring *P* will force the sleeve into its former position, allowing the spring *H* to expand and causing the cutter *F* to be withdrawn.



Combination Boring and Recessing Bar

The cutter *F*, as may be noted from the detail view, is round in section above the washer. This construction allows the coil spring *H* to operate freely on it. A retaining screw holds the spring in place; this screw is removed so that the cutter can be taken out when it is desired to grind or replace it. The screw has a hole in it through which the cutter may slide freely when in operation. Cutters *B* and *C* perform boring and facing operations, respectively, and are held in the bar by the familiar wedge construction. The operation of this boring and recessing bar requires, of course, that the turret and cross-slide operate in conjunction, so that the operator may set the bar and the stops in the correct position for machining the work, without regard to the depth or location of the recess. This operation is timed and governed by the feed regulation and length of dwell of the cross-slide, a feature of multiple tool work which is quite convenient. The use of this bar for work which requires either facing, boring, or chamfering and recessing operations has given very satisfactory results. M. F.

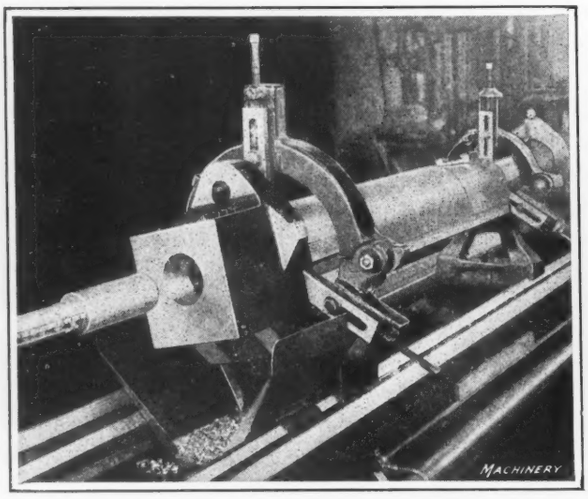


Fig. 28. Gun Body mounted in Lathe Ready for Powder-chambering Operation

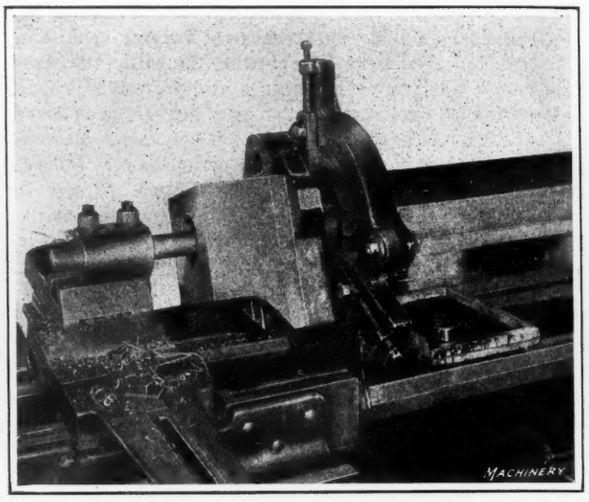


Fig. 29. Powder-chambering Operation completed, Reamer not yet removed from Gun Bore

Making the U. S. 75-Millimeter Field Gun

Second of Two Articles Describing the Methods Developed by the Wisconsin Gun Co., Milwaukee, Wisconsin in Producing Light Field Artillery

By ERIK OBERG

THE preceding article, published in the March number of MACHINERY, described the methods of tell-taling and boring the tubes, boring the jacket and shrinking it onto the tube, boring and threading the breech-ring, and planing the outside of the gun body. The following article will treat of operations on the clip, slotting the breech recess, boring fixtures, miscellaneous jigs and fixtures, and the various operations on the breech-block.

Operations on the Clip

The clip is bored in a turret lathe, and is shrunk onto the tube in its proper place. The gun body is then placed in a lathe and powder-chambered as shown in Figs. 28 and 29. The reamers used for this operation are illustrated in Fig. 34. The roughing reamer shown to the right has notched blades for breaking up the chips, while the finishing reamer has a smooth edge with wood packing on the body to prevent chattering and to insure producing as smooth and accurate a hole as possible. Both the reamers shown to the left are finishing reamers, the one in the middle being provided with a pilot and wood packing, which are removed in the reamer to the extreme left. The pilot at the end of the reamer accurately fits the bore of the gun.

Slotting the Breech Recess

The next operation consists in slotting the breech recess in the gun body, on an 18-inch slotter. The fixture shown in Fig. 30, which is employed for this work, is provided with a baseplate mounted on the slotter table. On this baseplate is mounted a bed, hinged at one end to provide adjustment for slotting the rear side of the breech recess, which is at an angle with the face. After the vertical sides have been finished by the slotting tool, the fixture is raised at one end, and a ground key is inserted into the slot shown in the side of the bed, thereby obtaining the correct angle for the rear side of the breech recess and insuring interchangeability. All the fixtures and jigs used for the gun body are made to locate it by the recoil slide and against the shoulder of the breech ring, these two surfaces having been previously machined true with the bore of the gun.

Boring Fixtures

Fig. 31 shows the boring of the hole for the operating shaft, as well as the complete tool equipment for this operation and the method in which the tools for the various operations are kept in this plant, boxes being provided with proper spaces for the tools. The boring-bar used for this

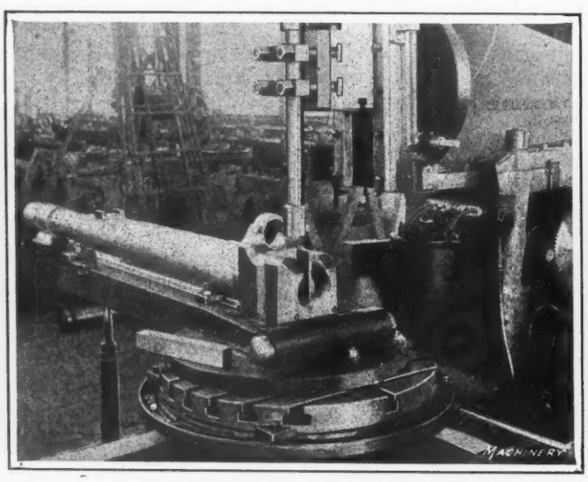


Fig. 30. Slotting the Breech Recess in Gun Body

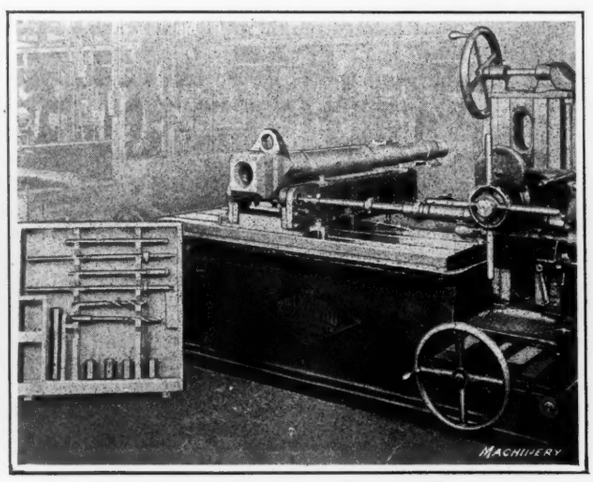


Fig. 31. Boring the Hole for the Operating Shaft

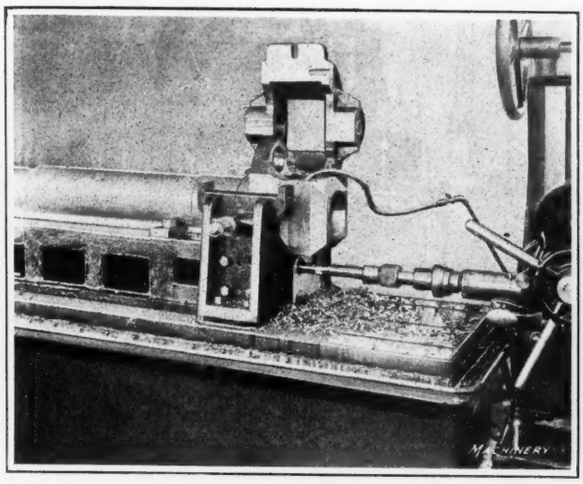


Fig. 32. Boring the Return Spring Holes

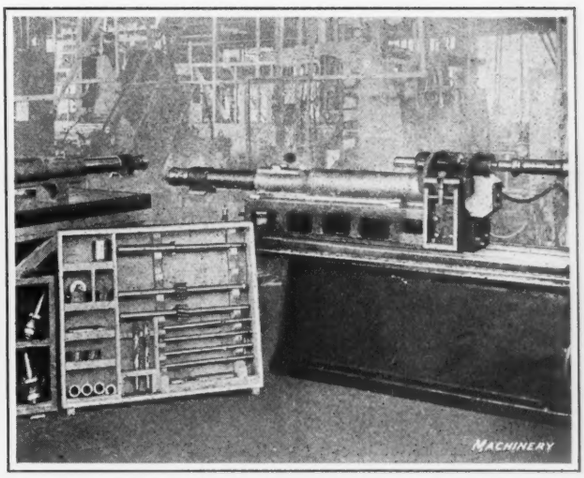


Fig. 33. Recoil Cylinder Hole being bored

operation is supported in a bushing at the other side of the fixture in order to insure a true hole being bored. The boring of the return spring holes, as shown in Fig. 32, is performed in a somewhat similar manner. The same fixture is also used for boring the recoil cylinder hole. As will be seen in Fig. 32, there is a large hinge at the top, containing holes for guiding the boring-bar. When boring the recoil cylinder hole, this hinge is brought down into position, so that the boring of the two holes can be done in one setting. At the front of the fixture will be seen the clamping bolt used for clamping the hinge when in the lower position. Fig. 33 shows the hinge brought down, clamped in position, and the recoil cylinder hole being bored. This illustration shows also how the complete tool equipment for each operation is kept in a box by itself.

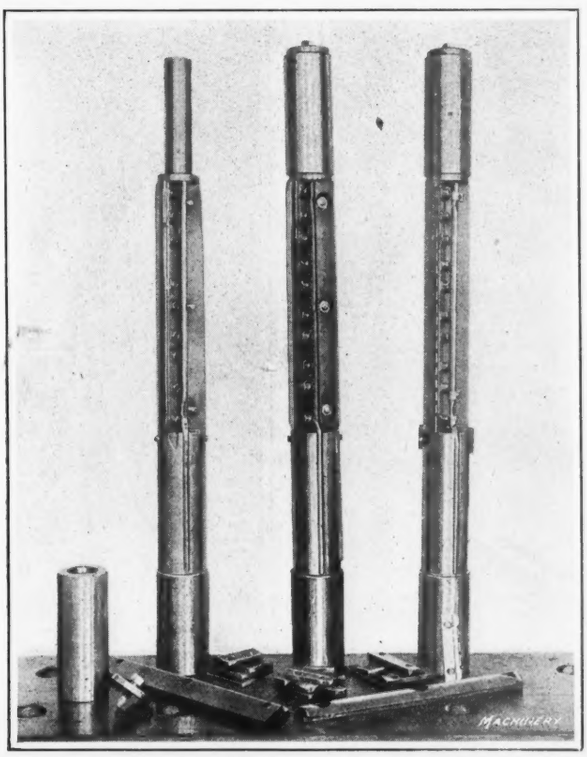


Fig. 34. Reamers used for Powder-chambering Operation

Miscellaneous Jigs and Fixtures

Other simple operations on the breech end of the gun body are shown in Figs. 35 to 38, inclusive. Fig. 35 shows the milling of a flat surface on the breech-ring. Fig. 36 shows the milling of a curved surface over the recoil cylinder hole. Fig. 37 shows an end-milling job in an awkward position, and Fig. 38 a form-milling job for shaping the lower side of the breech-ring.

An interesting drilling jig used for drilling a number of holes in the gun body is shown in Fig. 39. The gun is laid in a cradle or box provided with means for rotating it. This method of mounting the gun body in the jig permits the drilling of all the holes required at the various angles necessary. Stops are provided for the purpose of locating the gun in the various positions.

Fig. 40 shows the broaching of a square hole in the return spring lug. Four broaches are used for this operation. The hole is tapered on the under side but square on the top. In order to obtain the taper effect, a special tapered wedge is used in connection with a square broach. A special machine for finishing the trunnion

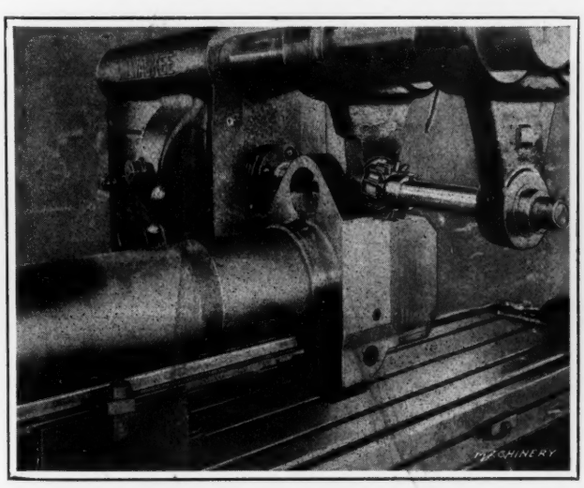


Fig. 35. Milling a Flat Surface on the Breech-ring

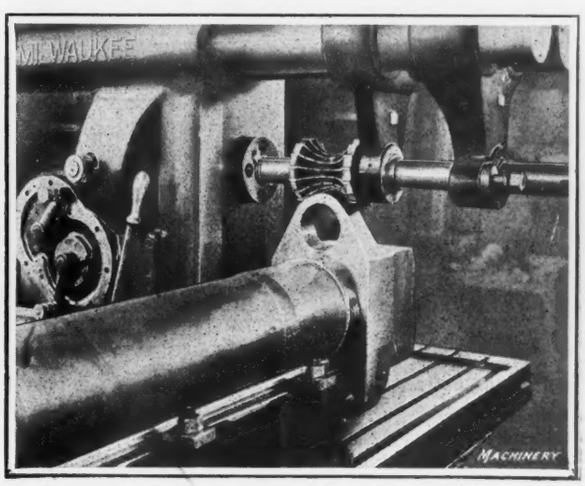


Fig. 36. Milling Curved Surface over Recoil Cylinder Hole

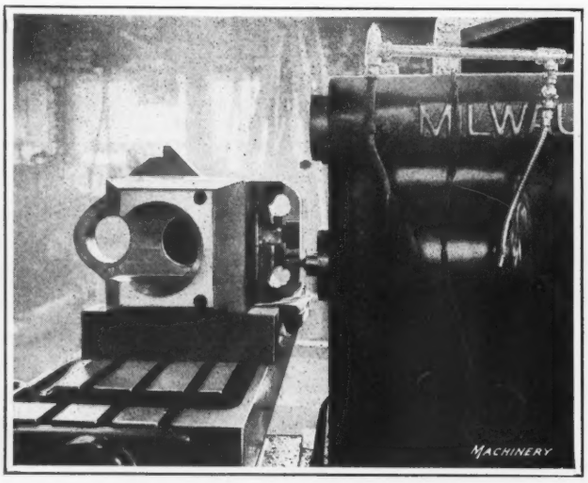


Fig. 37. End-milling Job on Breech-ring

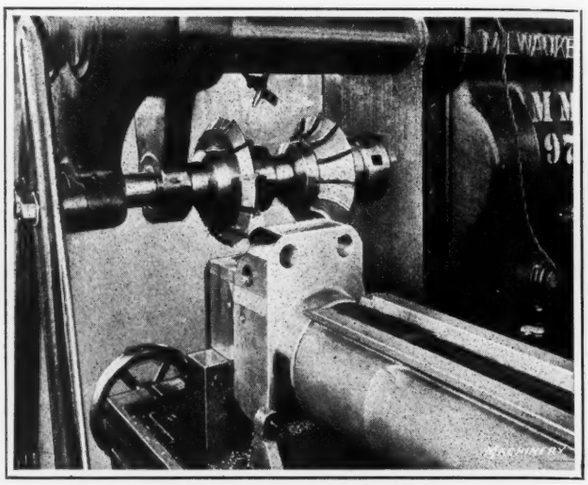


Fig. 38. Form-milling Job on Breech-ring

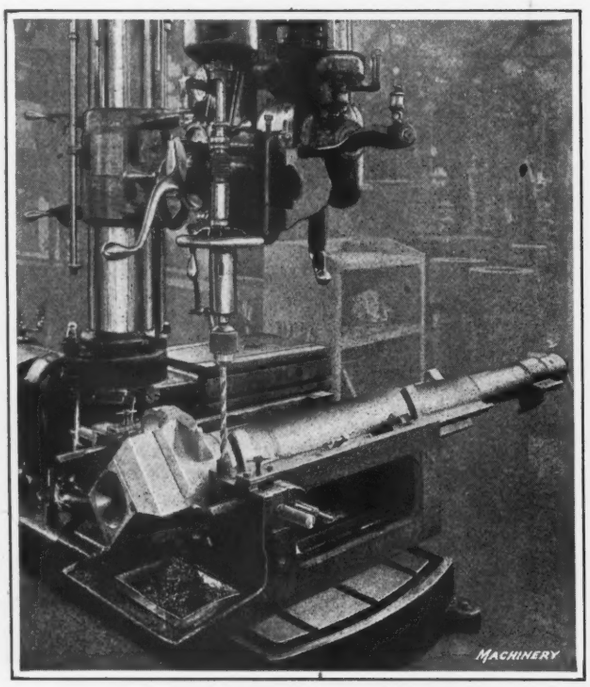


Fig. 39. Cradle Drilling Jig used for drilling Holes in Gun Body

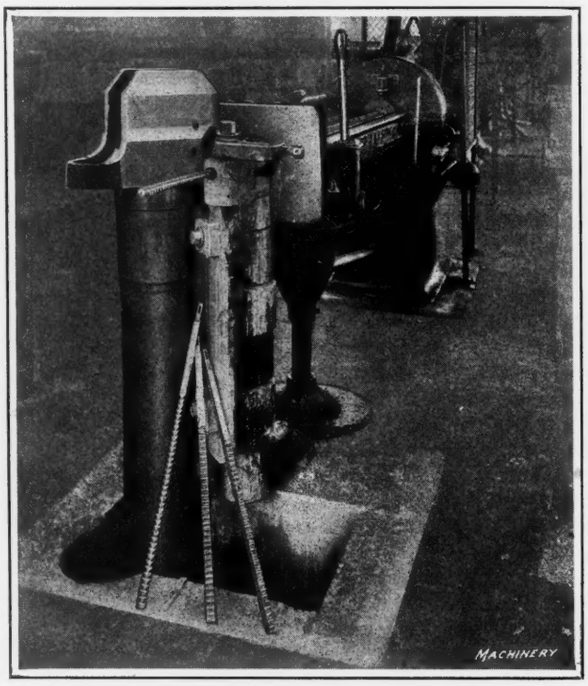


Fig. 40. Broaching a Square Hole in the Return Spring Lug

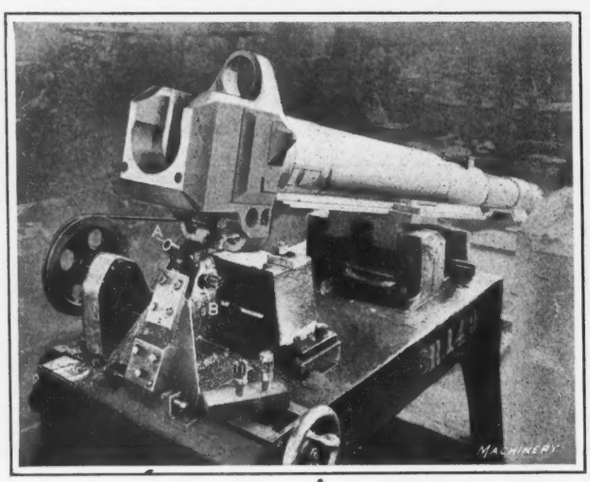


Fig. 41. Machine for finishing the Trunnion Seats for the Extractor

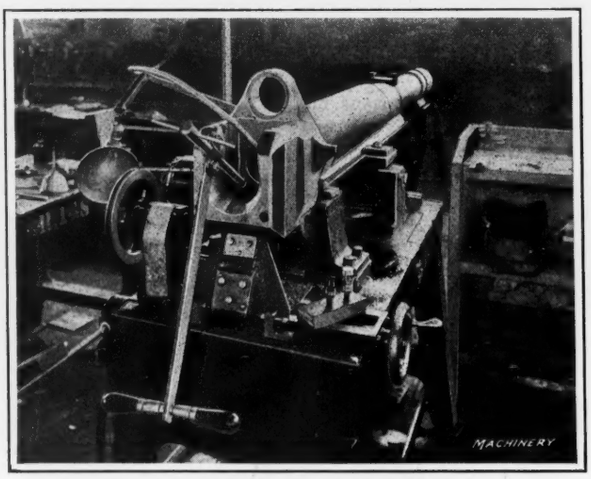


Fig. 42. Gun brought down over Cutter in Machine shown in Fig. 41

seats for the extractor is shown in Fig. 41, with the operating handle removed and the gun in position ready to be brought down and clamped. It will be seen that the fixture is provided with a cutter which, when the gun is brought down, is inside the gun, this cutter being moved or fed by means of a handle screwed into the hole *A*. Fig. 42 shows the gun brought down over the cutter and the operating handle for feeding the cutter in position. This is an ingenious mechanism, and is a good illustration of the many special methods and devices that were developed for the

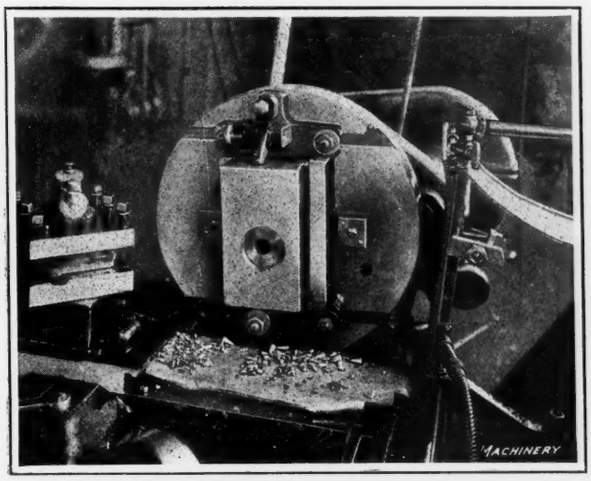


Fig. 43. Fixture for boring Firing-pin Hole

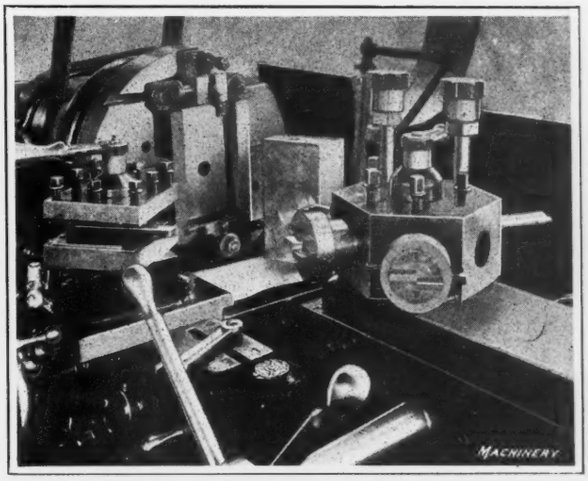


Fig. 44. Top Slide removed from Base of Fixture

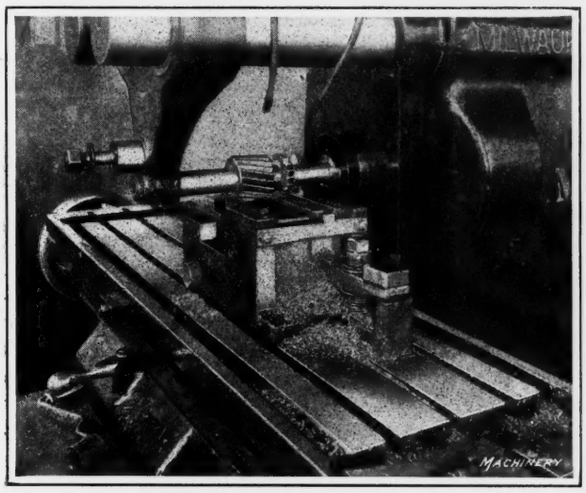


Fig. 45. Milling Fixture used for performing an Operation on the Breech-block

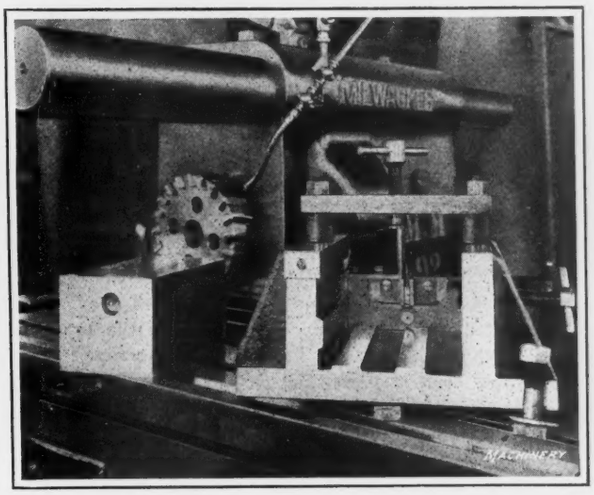


Fig. 46. Fixture with Indicator which points to Zero when Work is properly located

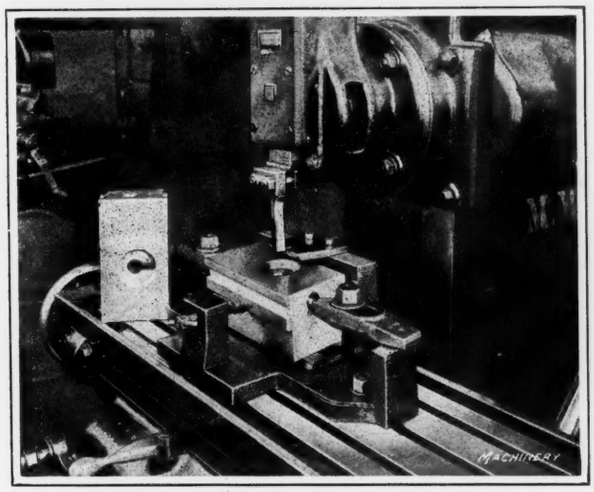


Fig. 47. Slotting Operation on a Milling Machine

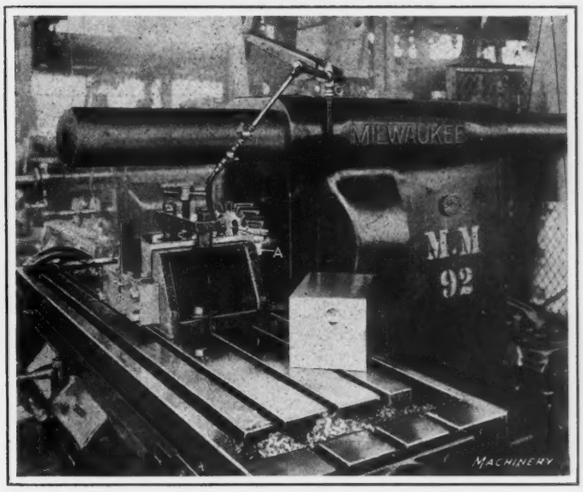


Fig. 48. Milling Fixture with Setting Block

economical and rapid manufacture of guns. The cutter is driven by means of a round belt and pulley, as shown to the left in Figs. 41 and 42, and the handle is used only for feeding the cutter or swinging it to conform to the trunnion seat. The groove or slot in which the cutter moves may be seen in Fig. 41 at *B*.

Operations on the Breech-block

A number of operations on the breech-block are shown in Figs. 43 to 49, inclusive. Fig. 43 shows a fixture for boring the firing-pin hole in the breech-block, mounted in position in a lathe, the construction of the fixture, slightly modified, being shown in Fig. 53. The firing-pin hole is not concentric with the "faceplate" hole. Both holes are bored in the same fixture, however, by indexing it to suit each hole. The two holes at *A* and *B* are for clamping when indexing. The fixture consists of two parts—a base and a slide—the slide moving the required amount to permit boring both holes in their proper positions. The top part fits rigidly into the slide in the base, so that all that is required to hold it in position after having been moved is one pin. The reason why the two locating holes *A* and *B* are not placed on the

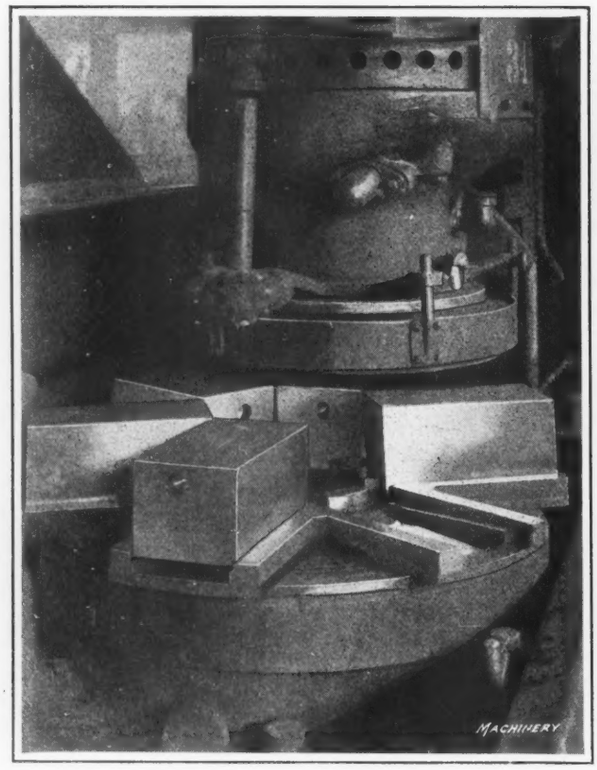


Fig. 49. Fixture used on a Magnetic Chuck for holding Breech-block

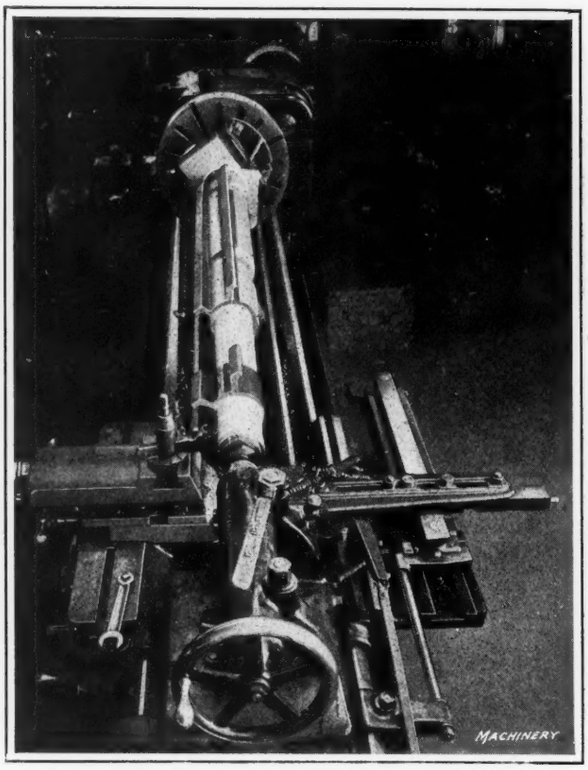


Fig. 50. Turning Muzzle End and Taper between Clip and Jacket

center line is that if they had been so placed they would have come too close together. Fig. 44 shows the top slide removed from the base of the fixture in the machine. Some changes have been made in the fixture shown in Figs. 43 and 44 from the design indicated in Fig. 53, but the principle remains the same.

Fig. 45 shows a milling fixture for an operation on the breech-block. An interesting feature of most of the fixtures used for the breech-block and for a number of other parts is that they are so made that it is practically impossible for work that has been erroneously machined in a previous operation to enter the jigs or fixtures in a subsequent operation; that is, the jig actually performs the function of a gage. Hardened stops are also commonly used for locating the work, and some of the fixtures are so arranged as to have an indicator which will point to the zero mark when the work is located in the proper position. A fixture of this kind is shown in Fig. 46. In Fig. 47 is shown a slotting operation performed on a milling machine by means of a slotting attachment.

Fig. 54 shows a detail view of the milling fixture in Fig. 46, provided with an indicator to show whether the work is properly located against stop *A*, and also with a block *B* for setting the cutter. This block also prevents cutting into the work accidentally. The block is hardened and is of such thickness that to set the cutter properly requires a feeler

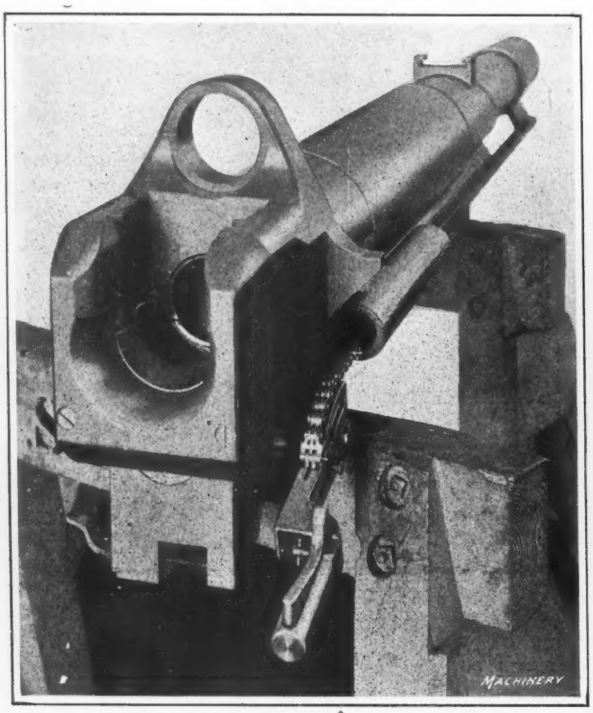


Fig. 51. Breech End of Completed Gun Opened

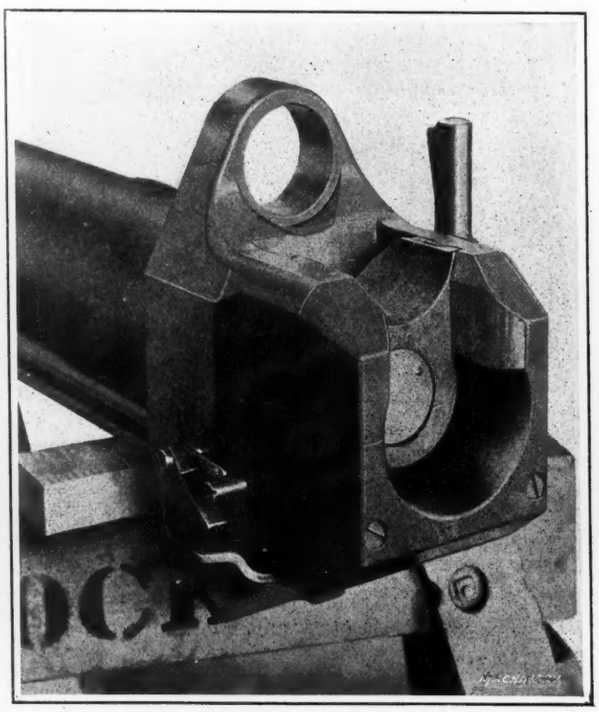


Fig. 52. Breech End of Completed Gun Closed

0.005 inch thick between the block and the cutter. If the cutter is not properly set, but is too far in, so that it would cut into and spoil the work, it would first strike this hardened block. This would spoil the cutter but would save the work and, considering the many preliminary operations that have been performed on work of this kind in many instances, it is much cheaper to replace the cutter than to have the work spoiled. Fig. 48 shows clearly how a setting block as described would save the work, as the cutter would first dig into the block. Here the block is shown at *A*, and the cutter must pass it before it will reach the work.

Fig. 49 shows a special fixture used on a magnetic chuck for holding breech-blocks, which permits the grinding of the proper taper on the blocks. The fixture permits six breech-blocks to be ground at once. Fig. 50 shows a gun in a lathe for turning the muzzle end and taper between the clip and the jacket. To perform this work, a special bar is machined to give the proper shape to the muzzle end, this bar being fastened to the taper attachment as indicated. By this means, the two surfaces shown turned toward the tailstock end of the lathe are finished. Figs. 51 and 52 show the breech end of the completed gun, open and closed, respectively.

* * *

Arc-welded sheets have been tested by the Bureau of Standards for the Steamboat Inspection Service to determine their availability for lifeboat construction. Tension tests showed the arc welds to be 100 per cent efficient. Alternating stress tests showed that the welded section was not injured appreciably during the process of welding.

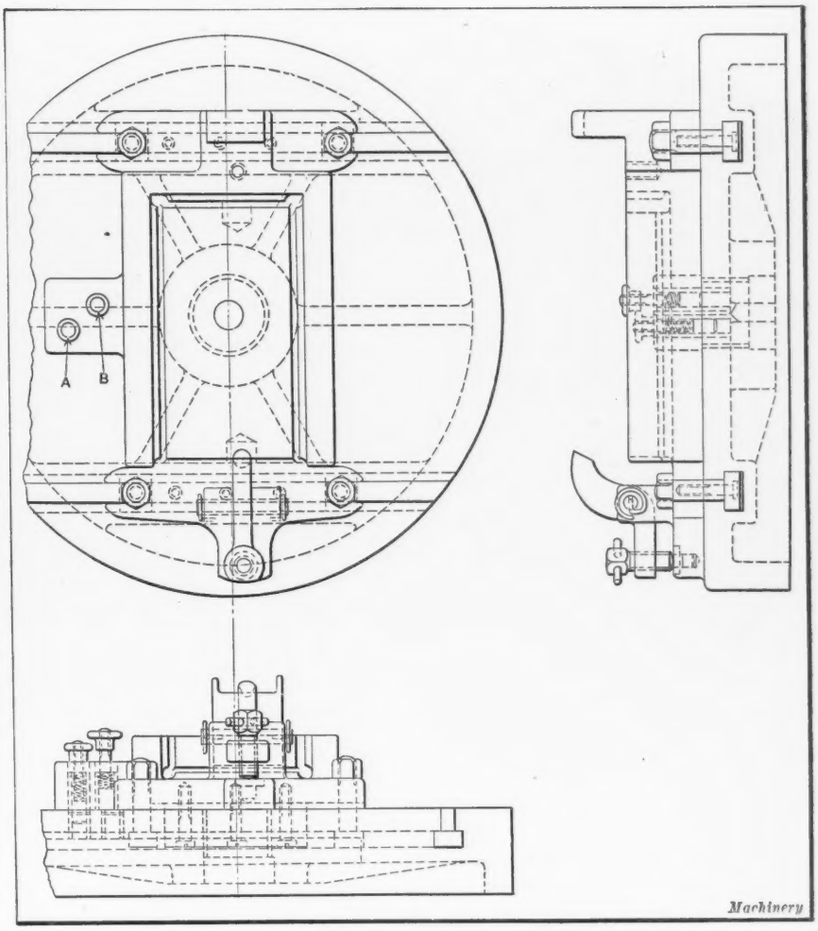


Fig. 53. Detail Views of Fixture shown in Fig. 43

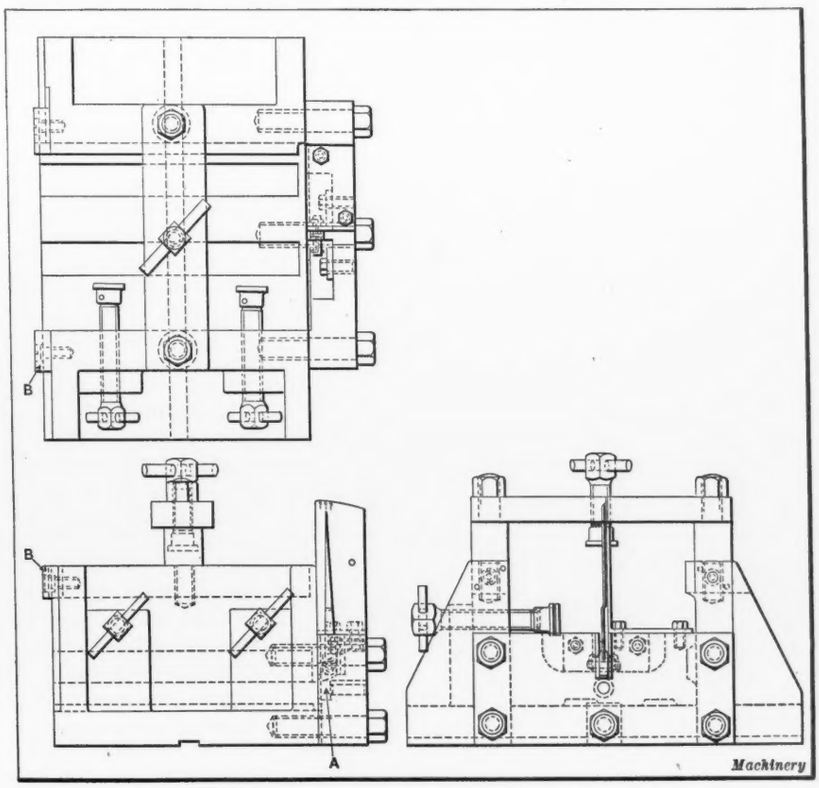
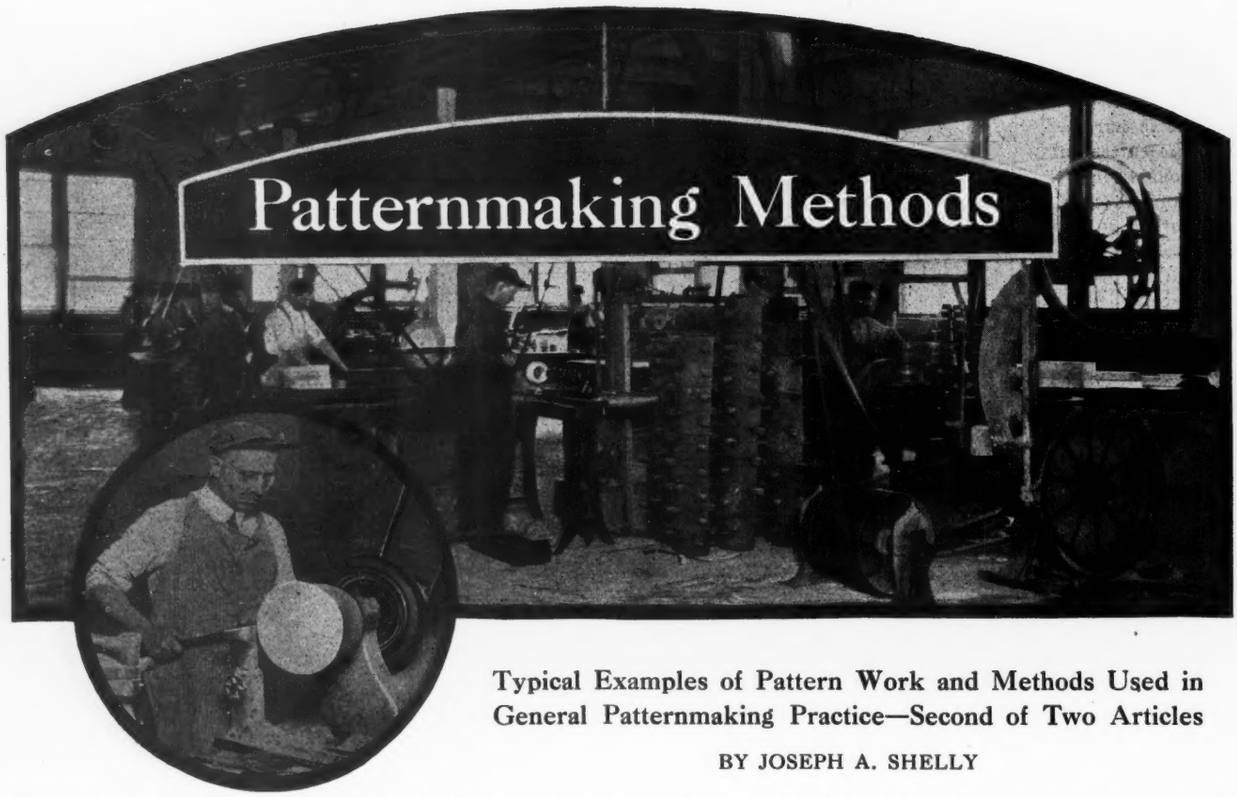


Fig. 54. Details of Milling Fixture shown in Fig. 46

EMPLOYMENT OF THE BLIND

Several experiments in the employment of maimed or otherwise handicapped men have been made by the Miller Lock Co., of Philadelphia, Pa. The unusual experiences of this company in employing blind men are told in an article by Dale Wolf in a recent number of *Industrial Management*. The Miller Lock Co. has employed blind operators on light drilling machines. Formerly boys were used to operate these machines and it was observed that the boys seldom looked at their work; this led to the experiment of training blind men for this operation. Of course, some care was necessary in designing the drill jigs for the use of blind workers, and careful instruction was necessary to a larger extent than with seeing workers, but the project has, nevertheless, been a success. A man who was operating a drilling machine and was himself physically handicapped, was selected to be the supervisor for the blind men. It was felt that this type of man as a caretaker would have the proper appreciation of the affliction of others. The duties of this supervisor consist of looking after the general needs of the men. The blind have proved to be successful producers, in spite of their handicap.

The unusual experience of the Miller Lock Co. in employing blind workers on these drilling machines is one that may have its after-effect upon methods to be adopted for employing the blind soldiers who are returning from Europe.



Patternmaking Methods

Typical Examples of Pattern Work and Methods Used in General Patternmaking Practice—Second of Two Articles

BY JOSEPH A. SHELLY

IN the previous article, published in the March number of MACHINERY, methods were described for making patterns for levers, wrenches, brackets and frames, cranks and eccentrics, cams, pillow-blocks and caps, as well as duplicate patterns and patterns requiring small cores. The present article will deal with patterns for linings, bushings, and boxes; steam chests, slide-valves, valve seats and stems; pistons; cross-heads; pipes; air chambers and engine beds.

Linings, Bushings, and Boxes

Linings, bushings, and boxes are castings that are fitted into different parts of a machine for the following reasons: (1) to provide for easy renewal in case of wear; (2) because they possess anti-friction qualities not possessed by the material of which the machine is built; (3) because they are needed for taking up wear. Linings and bushings are usually complete cylinders with or without flanges, and patterns for them may be made to mold on end or by parting, the method depending largely on the size. If short in proportion to the diameter, they can safely be made on end, but if long and slender, it is perhaps better to part them, although it is the practice in some shops always to mold them endwise so that any length can be made from one pattern by "drawing up." Of course, they should be given a fair amount of draft for this purpose. Metal patterns which leave their own core openings through the lining where it crosses the port at the flanged end. These patterns are turned to the size of the bore at this point (see view *A*, Fig. 10) and the connecting bars or grids are fitted in place, those that under-cut being loosely skewered in place for "picking in."

Boxes are usually made in two pieces and are used to line bearings; they may be plain half cylinders with or without flanges, or they may be of cross-sections such as shown at *B*, Fig. 10. The end pieces are usually turned or otherwise worked out first, and fastened to the piece that forms the central portion, the working of the half-round openings being left until last. In using turned ends, a little more than half the circle is required on account of the draft and this makes a little back draft which may be disregarded if it is small and the amount of finish is slight; but if the ends are of good size they may be turned in halves and pieces glued to the joint to make up the finish. Half-round boxes are laid out on both ends and the inside is roughed out and finished before the outside; or if a good band saw is available, they may be cut inside and out close to the line, leaving very little hand work for finishing.

A method of making numbers of half-round linings for filling in branches in a core-box is as follows: Plane the inside with a core-box plane and then fasten two of the linings with screws to a mandrel in the lathe and turn the outside. This is also an economical way of making maple boxes for wood pulleys. A large box, however, should be built up on two or three forms, as at *C*, Fig. 10, which are left in the pattern to hold the shape and are "stopped off" in the foundry. The forms should have plenty of draft on each side to mold easily.

are often used for large linings, and various lengths are made by the same process.

What are known as removable linings are used in some pumps and other cylinders. They are provided with a flange for bolting either to an inside facing in the end of the cylinder or to the flange on the outside, the flange coming between the cylinder head and flange. In the latter case, there must be

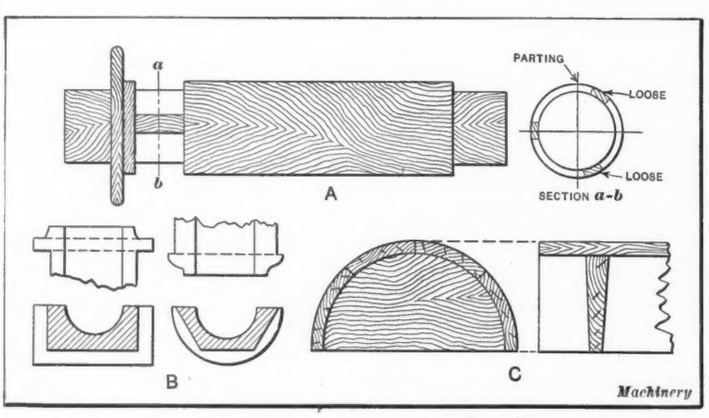


Fig. 10. Patterns for Linings, Bushings, and Boxes

Steam Chests and Slide-valves

Steam chests for direct-acting pumps are

designed for operating what are known as "steam-thrown" valves; there are many styles of these valves, and the chests are more or less complicated, corresponding to a sort of small engine that actuates the valve. The chest for an ordinary slide-valve is a square box with a hub on one end for a stuffing-box for the valve stem, and a pad on the other end or on one side with an opening for the entrance of the steam pipe. The chest is constructed usually so as to make its own core, with the projecting pieces on the sides or ends skewered for "picking in." As a rule, there is a projecting flange on the inside at the top and bottom, and one of these must be loose to mold in a three-part flask. One of these flanges is machined for fitting the projection on the breast face, and also to provide a guide for the valve. Clearance should be cut in the square corners for the planer tool. When there are openings in opposite ends, a lug is sometimes cast in the center of the steam opening as at *A*, Fig. 12, so that the valve stem will be supported at both ends; this lug is placed in the core-box that makes the opening. The holes for the studs are usually cored under size for drilling in a jig. To avoid drilling a number of deep holes, they are chambered so that the drill acts on only about ¾ inch of the metal at each end, as shown by the section at *A*.

Slide-valves or "D-valves," as they are sometimes called, have one or more cavities on the face. The pattern *B* is made of three pieces, the cavity being worked from the central piece, and the two side pieces being made thick enough to form the corner fillets.

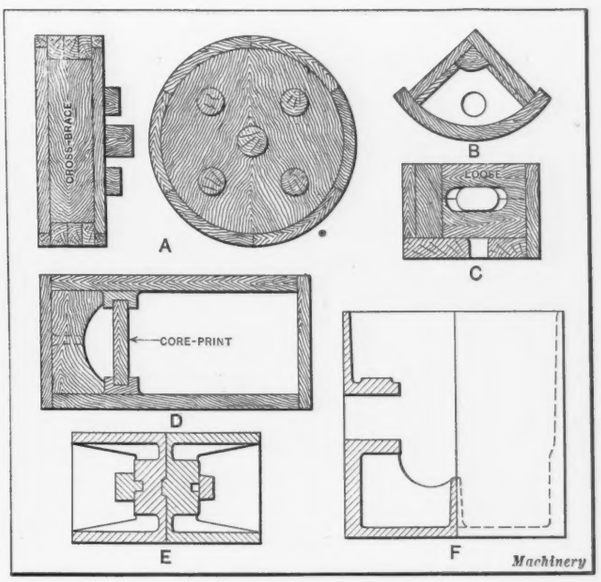


Fig. 11. Piston Patterns

Valve Seats and Stems

Pump valve seats should be made of hard wood, turned with the grain of the wood running parallel with the axis, as it is easier to work the ribs when made in this way and the pattern is stronger and not likely to shrink unevenly. The spaces between the ribs at *C*, Fig. 12, are bored away with an auger bit and finished with a chisel and gouge with about 1/64 inch draft on each side. The outside should be tapered ⅛ inch per foot, which is standard.

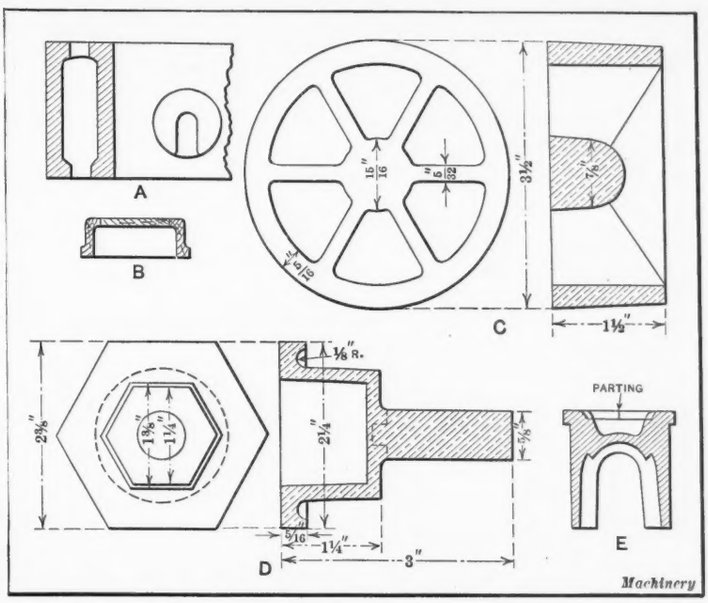


Fig. 12. (A) Section of Steam-chest Pattern. (B) Section of Slide-valve Pattern. (C, D, and E) Pump Valve Seat, Stem, and Cage

A valve stem *D* screws into the seat and holds the spring against the valve; it has an internal hexagonal recess for a socket wrench. The pattern is turned up to the top of the fillet, flatwise of the grain, and the round stem is made with a pin to fit a hole bored in the pattern, as indicated by the dotted lines. A valve cage *E* is used to confine a ball valve to its seat. The pattern is made with the recess in the top to leave its own core. A round lifting handle extends across the recess, and this is notched in at each side to make the joining fillets, and is parted at the center to draw each way when the cope is lifted. A single dowel-pin in the center keeps the pieces in their proper relative positions. This pattern is turned to a templet inside and is laid out and cut away to form the four fingers that encircle the ball.

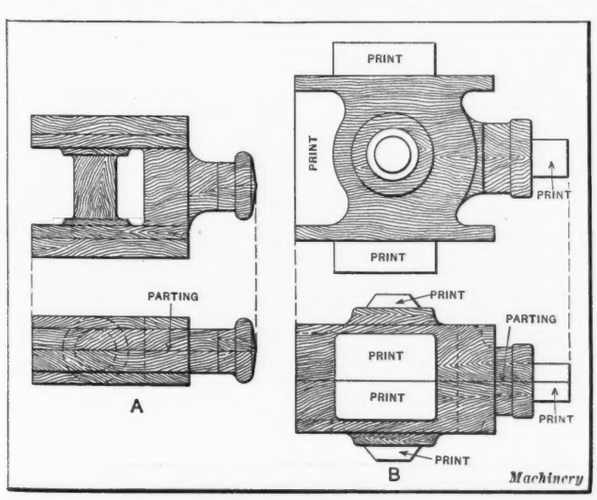


Fig. 13. Cross-head Patterns

Piston Patterns

Patterns for pistons do not present any very difficult molding problems; they are generally built of segments, and if they are of the ribbed type, the ribs on the cope side are left loose. Cored or hollow pistons are plain cylinders with a central core-print for the piston-rod hole and a number of prints for holes to support the interior core, as shown at *A*, Fig. 11. The pattern shown has segments with the heads let in, and is furnished with a cross-brace extending across the grain of the heads to provide for rapping and lifting. The core-box, in this instance, was a full turned box with the interior core holes cut through the bottom and a hub to provide metal around the piston-rod. These pistons often have ribs or partitions that divide them into equal spaces with an opening through each connecting rib. In such a case the core-box is usually a part one, as illustrated at *B*, with a half rib in each side which parts through the center of the rib opening as shown by the sectional view *C*.

A trunk piston *F* may be parted or made to mold on end; on account of the projecting bosses it has to be cored, and the box may be either a half or a whole one. The half-box

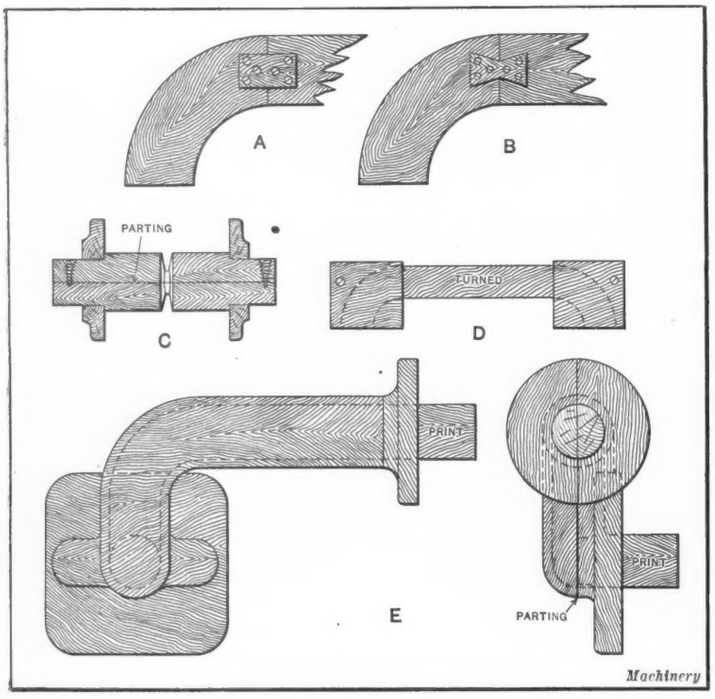


Fig. 14. Pipe Patterns

D has a cross-rib at the joint and two loose bosses. The bosses are connected with a half-round print which makes the opening through which the round core is pushed to form the hole in the bosses. A batten doweled across the face of the box with the loose pieces fastened to it is used to locate these pieces. Plunger *E* is a long piston which is parted in the center. Some types of plungers are plain hollow cylinders with a small opening in each end, chambered inside to reduce the thickness of the metal. When they are of this form, the pattern should be made to mold on end, and it should be about two inches too long in order to provide a riser to catch the dirt that always rises to the top of the mold, as it is necessary that a plunger be of sound metal throughout.

Cross-head Patterns

The two cross-head patterns shown in Fig. 13 will serve as illustrations of the principal types. The style shown at *A* is used on some pumping engines; it rests in a horizontal position on the guides and is not adjustable for wear. The pattern is made as illustrated, unless it is very large, in which case the sides and cross-piece are framed. This pattern is parted, and the wrist-pin, bosses, and connecting-rod end are turned and fitted to the pattern; the two raised strips on each side are also applied. In fitting the wrist-pin, the bosses are put in place and a socket is cut in each side to take the pin, which is turned long for this purpose. To lighten the casting, rectangular openings are sometimes cored through the sides from end to end, and this requires core-prints and a core-box. When designed to be cast in steel, all the corners, even those that are to be machined square, should be filleted, as it is impossible to make square corners on steel castings.

A cored cross-head *B* is made by building the side thickness on a block large enough to make the body of the cross-head extend up to the line where the turned piston-rod hub is fastened on. Another method is to plane a block the full thickness, and then shape or cut it down to form the print at the end. This block must be parted and doweled together. The side-prints, bosses, and core-prints on each side are made separately and applied. A half core-box is required to make the inside with bosses around the wrist-pin holes, as well as these holes and the hole through the piston-rod hub. Separate cores are sometimes used for the wrist-pin holes, as it is easier to set the main core when these are separate, and the hole is sure to come in the center of the hub. This cross-head has shoes fastened on each side for use in a bored slide, but the sides themselves are sometimes curved to fit the guide, in which case the cross-head will be open at one end or perhaps the core will cut through at the piston-rod hub end and core-prints will be required to support it.

Pipe Patterns

Pipe patterns are usually turned in sections and fitted together to form the different combinations of curved and straight parts, but many pipes are of such form that they can only be partly turned or must be worked to form entirely by hand. When a single bend of any size is required, it is more economical to work it by hand to a templet, first reducing the bend to octagonal form. The sections of built-up pipes are fastened together by inserting screws through the heads, but smaller pieces made of solid stock will have to be fastened by screws driven at an angle, at the joint. It is not the usual practice to glue the sections together, as they are used for making any needed combinations. In some shops they are connected by pieces let into the joint as at *A* and *B*, Fig. 14; these pieces are, as far as possible, of standard sizes and interchangeable. Pipe flanges are usually made of standard size so that they can be used with standard fittings if it is desired to do so. This is also the case with air-chamber flanges and other flanges and pads designed for pipe connections. If flanges to fit the ends of bends are turned on the prints, as at *C*, this will save fitting the prints and insure centering, but if the flanges are large, they will have to be turned on a faceplate and the prints will probably be turned with the grain the opposite way. Large prints having a good bearing surface are easy to fasten by screwing through the face side. A small steam pipe with a bend at each end that is to be worked from the solid has the straight part turned as at *D*, and the bends cut as indicated by the dotted lines. Another example of a part-turned pattern is a governor elbow *E;* the straight section is turned and the rest worked by hand. This is also a good illustration of a parted pattern where the pattern and molder's parting will not coincide. A full core-box is used for this kind of pipe, and one half must be thick enough to make the hole where the core turns at a vertical right angle.

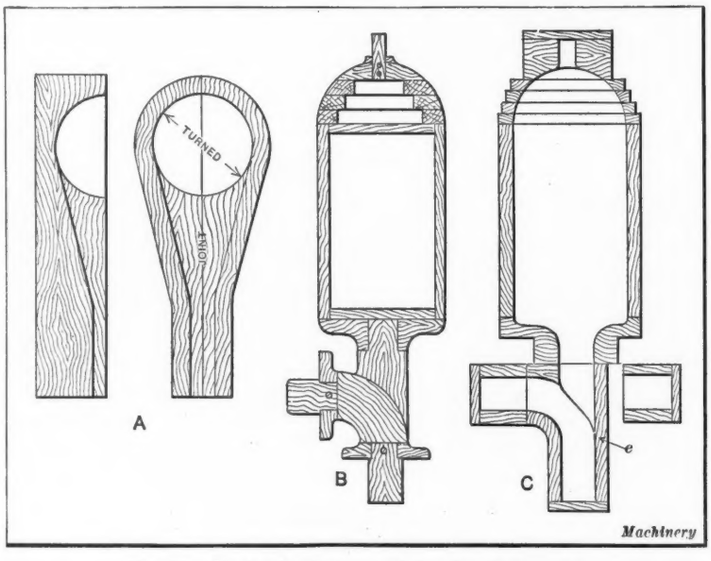


Fig. 15. Air-chamber Pattern and Core-box Construction

This hole should be given plenty of draft and the core-print made to suit.

Flanged branches at an angle to the axis of the pipe will have to be made loose, and the flanges also will be made loose, unless they form a right angle, when the branch may be fast and the flange loose; these are molded with a covering core as previously explained. In making the different sections of pipe, great accuracy is required if the pieces are to be assembled with the minimum amount of fitting.

Air-chamber Patterns

Small air chambers are turned from solid pieces and have a long core-print to help hold the core, as there is usually no opening at the top. It is not possible, in most cases, to balance the core, and the molder usually has to use chaplets to support the core and secure a uniform thickness of metal. The turning is done to a templet, and the spur center should be set in the large end, on which a straight boss is turned for one end of the templet to rest on. The other end has a bearing on the print, which is first turned to size. Owing to the large differences in diameters, which tend to cause the joint to open as the stock is turned away, an extra screw should be placed in the center to hold the pieces together.

If the pattern is large, both the pattern and core-box will have to be built either by the stepped or stave methods or by a combination of these methods, as shown at *B* and *C*, Fig. 15. If the core-box is small, the stock may be jointed through the center and the circular part turned as at *A*. This will permit laying the rest of the box out on the joint as well as on the face, which is very helpful when gouging it out, as there are two sets of lines to work to. Large air-chamber patterns are constructed with a view to possible alterations, and are fastened with screws but without glue. A plan of the joint of a pattern constructed in this way is shown at *B*. The same plan is followed in constructing the core-box *C*. This core-box is built on a bottom board, and the feature of its construction is the means employed to make the core right and left by means of right- and left-hand elbows *e* that can be changed at will. The ends of this box may be turned, but if it is quite large it will be found more economical of both time and lumber to build it up and work out the form by hand.

Engine Beds

The lighter types of engine beds are usually made to leave their own cores, with the exception of the pillow-blocks which are lightened by cores located by prints placed on the under side. These bed patterns have particularly interesting constructional features. The end rib is sometimes dovetailed and the intermediate cross-ribs dadoed into the sides and screwed from the outside. The spaces between the ribs are rammed up on iron plates and lifted out to draw the pattern and free the loose projecting pieces on the sides. This is also the way lathe and planer beds are molded. A cored bed should be boxed on good stout pieces, as indicated in Fig. 16; or, if large enough to warrant it, on framed partitions fastened at the corners with half-lapped joints, glued and screwed as shown at *C*, Fig. 17. This system of framing should be carried out at the pillow-block end where the tendency is to ram the pattern either in or out unless the framing is very stiff. By making the framing of fairly heavy stock and putting the cross-pieces quite close together, much lighter material can be used for the sides.

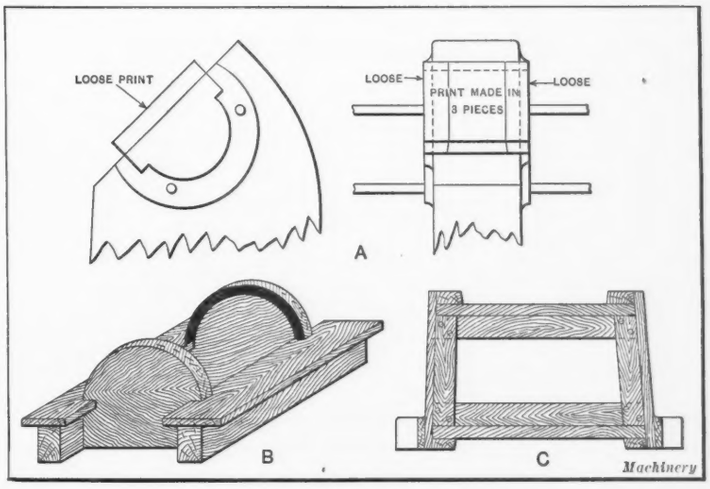


Fig. 17. Details of Engine-bed Pattern Work

The cross-head slides are made separate, with a core-print on the face where the core cuts through, and the projecting side pieces are skewered for "picking in." The half bosses on the pillow-blocks are loose, as is also the core-print on the face, which is cut in three pieces so that the undercutting portions may be drawn in when the central section is taken away. The central piece should be wider than the other two, as shown at *A*. This is also the case with the core, which is made in a skeleton box *B* and is cut into three sections by pieces of sheet iron fitted into the box. This box has loose pieces on each side to form the ledges or projections for holding the babbitt; the projections on the ends are formed by a strickle. A single core-box of the same length as the longest section between the ribs, plus the thickness of the thickest rib, is used to make all of the principal cores. One end of this box is square and the other corresponds to the taper of the end of the bed. It is a good plan to lay out the length of the cores on a rod for the guidance of the core-maker, numbering them 1, 2, 3, 4, etc., beginning at the pillow-block end. Each section will probably have one rib, and these are usually cut away to clear the cylinder flanges and other projections that come below the top of the bed. Where the rib is cut away it will have to be backed up by a blank rib to make the end of the core, as shown in Fig. 18. At the rear end there is usually an internal flange that must be placed in the box by screwing to the end. In locating the ribs to make the different lengths of core, they are not fastened, but bear against distance pieces placed loosely in the box that hold them in the right places. Fig. 18 shows the box set to make a length of core from the rear end to the next rib.

For the pillow-block end, a frame is constructed to fit inside the core-box so that a suitable thickness of metal will be formed around the sides and under the sloping floor between the pillow-blocks. Pieces are fastened to the sides of the box with battens and the top of the core is strickled. The inside of the cross-head slide is made in a separate box,

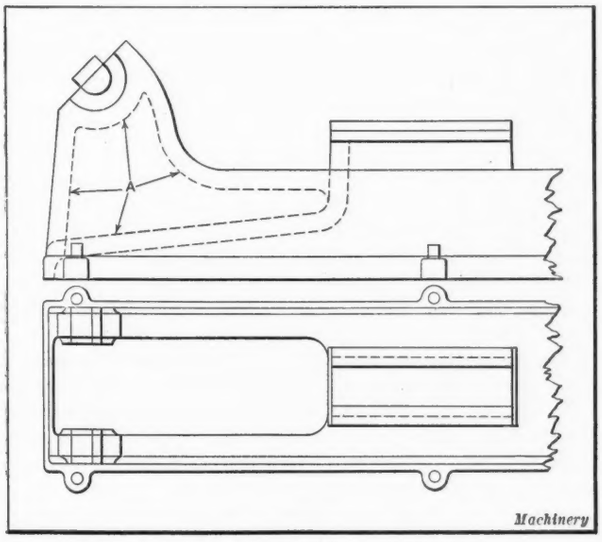


Fig. 16. End of Pattern for Engine Bed

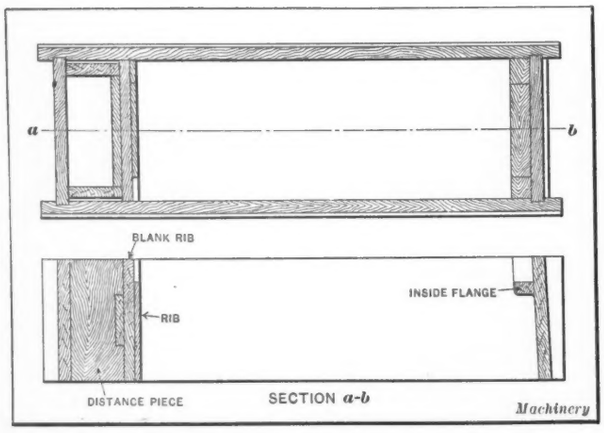


Fig. 18. Other Details of Engine-bed Pattern Construction

which is the full length of the slide with a loose rib in each end cut to form a semicircle at the top to clear the key wedges in the connecting-rod. The bolt holes in the side lugs should always be cored, and the centers should be located quite accurately, as it is customary to send plans to customers for building foundations and locating foundation bolts. Owing to the taper on the sides of the bed and slide, there is no necessity of making the core-box part. The slide should have an extra allowance for finishing to insure its machining centrally with the pillow-blocks. Certain types of narrow baseplates with pockets in the under side that do not open through are made as though to leave their own core, but a core-box is made to form cores that fit into these pockets, and they are fastened to bars in the cope for lifting away.

* * *

BUREAU OF STANDARDS INVESTIGATES APPLICATIONS OF ELECTROPLATING

Electroplating is an art which has been developed during the last fifty years with only occasional application of scientific principles. Of recent years, however, there has been a considerable demand from electroplaters and manufacturers for more exact data relating to this industry. This demand for information has been emphasized during the war by the numerous problems which have arisen in connection with the plating of military supplies. For instance, zinc plating has furnished an excellent and probably the best protection against the corrosion of steel parts, such as airplane and seaplane fittings. Black nickel plating was extensively used for producing what is commonly known as government bronze finish upon brass hardware and saddlery equipment. Lead plating was valuable in the lining of gas shells and for bringing shells which were under weight up to standard.

In connection with these problems a number of investigations were conducted at the Bureau of Standards, whose experts made frequent visits to munition plants to advise upon the best methods of securing the desired results. Appropriations have been requested by the Department of Commerce to permit a more exhaustive study of the plating problems and their application to various manufacturing industries. Pending the appropriation of funds adequate to conduct extensive investigations on electroplating, arrangements have been made by the Bureau of Standards to secure, by inquiries addressed to platers, reliable information regarding the kinds and methods of plating now in commercial use.

* * *

The exact nature and extent of German foreign trade before the war is shown in a statistical report published by the Bureau of Foreign and Domestic Commerce. Tables included in this report are designed for easy reference so that the goods ordinarily in demand before the war in various markets can be conveniently ascertained. These reports are issued under the title, "Statistics of German Trade 1909-1913, Miscellaneous Series No. 75."

SENATOR SMOOT ON THE INEQUITIES OF THE MAGAZINE POSTAL RATES

The following opinion, by Senator Reed Smoot, relating to the present postal rates on magazines and periodicals, will prove of interest. This statement was made in a speech on the floor of the Senate in discussing the revenue bill, which includes a provision for charging different rates of postage for sending magazines and periodicals to different parts of the country, this method being known as the "zone system."

"There is not a Senator," said he, "who does not know that you can handle a ton of second-class matter for less than you can handle a ton of first-class matter, not only in the cost of transportation over the railroad lines, but in the distribution of it. If we are to raise the rates, let them be raised, but, for Heaven's sake, do not chop this country up into zones. No other civilized country does it. I feel mortified as a citizen of the United States when I am told that from my own state a magazine can be sent to the farthest end of India for less money than it can be sent from my state to an adjoining state. You cannot defend that.

"As I said, if there is to be an increase, let the rate be increased and let the policy of all other civilized countries and that which our country has followed up until July 1, 1918, be pursued, that the information carried through the public press shall be carried to all parts of the country and to all citizens thereof at the same rate."

The second-class postal rate question will be brought up again in Congress. All readers of a mechanical journal like MACHINERY recognize the educational value of a journal of this kind, and should write to the senators from their state and to the congressman from their district, calling their attention to the injustice of the zone system and to the high rates that are charged under this system. In some cases, the zone postal rate for a copy of MACHINERY is higher than the subscription price. It is evident that a law that authorizes the zone system, which divides the country into sections, and rates that are so abnormally high, ought to be repealed. It is reasonable to pay for every service what it costs, but no business, and least of all one that is educational in its nature, should be required to pay a tax far in excess of the actual cost of the service rendered to it by the post office. Eventually, of course, this added increase in the postage must be paid by the subscriber. Why the subscriber of a mechanical journal should be fined because he has a desire to increase his knowledge of his trade is difficult to understand. Write to your senators and to your congressman and protest against this tax on the spreading of mechanical knowledge.

* * *

LEAGUE ISLAND NAVY YARD EMPLOYMENT DEPARTMENT

The Philadelphia Navy Yard on League Island comprises approximately a thousand acres, of which over forty-one acres are covered by the enlarged naval aircraft factory. Commander F. G. Colburn, manager of the naval aircraft factory at the Navy Yard, in a paper presented at the annual meeting of the Society of Automotive Engineers, discusses some Navy Yard employment methods. The responsibility for securing, developing and retaining a satisfactory personnel, outside the executive staff, was placed under the direction of an employment superintendent, one of the five main department heads who report to the manager. The specific functions assigned to the employment department originally included employment and training, but later, responsibility for a certain amount of factory follow-up and for all welfare work of the factory was added.

The theory that every employe had the right of appeal to the manager was followed. It was considered desirable to have a department, not responsible for production, which might consider both sides of each dispute and render an impartial decision. This responsibility was placed in the employment department, where grievances and charges of unfair treatment were regularly considered. The employment department also passed finally on nearly all rate changes and transfers and on all discharges.

Continuous Thread Milling Machine of Unusual Design

BY EDWARD K. HAMMOND

ONE of the well-known ordnance manufacturing companies was recently in need of a number of screws 6 inches in diameter by 90 feet in length, with triple threads of 4-inch lead. It will be apparent to any experienced machinist that the cutting of such screws presented quite an unusual problem, and the company in question called for bids on a special machine which would enable this operation to be performed in an expeditious manner. A. Morris Thomson, of the T. C. M. Mfg. Co., Hunterdon and First Sts., Harrison, N. J., worked out the design of a machine for handling this work, which is so unusual in many of its features that a brief description will undoubtedly prove of interest to machine tool designers. In addition to providing for simultaneously rough- and finish-milling the triple threads on these large screws, the machine is furnished with means for turning the bar down to the required diameter, ready to start the thread milling operation, which gives the advantage of bringing the axial center of the bar into accurate alignment with the milled threads.

All of the work is done at a single setting, so that no time is lost in transferring the bar from one machine to another and in setting up several machines. This continuous process avoids trouble experienced with a machine of the full length required by the work, through overcoming the necessity of adjusting the position of the tail-center to compensate for expansion of the work due to the heating action of the thread milling cutters. Also, a great economy in the amount of floor space occupied by the machine is naturally effected through the substitution of an equipment of this character in place of a machine having a capacity to hold the bar between centers, although it will be apparent that clearance space must be provided for the bar during the time that the machine is actually in operation.

Front, plan, and end views of this machine are shown in Fig. 1, and by referring to these in connection with the following description, the way in which the machine operates will be readily understood. At *A* is shown the bar of steel which is to be turned and threaded in the machine. This bar is carried by roller supports *B* so that it may be readily fed through the machine. In starting the operation, bar *A* is pushed through chuck *C* until it is engaged by a rotary cutter-head *D*, after which chuck *C* is tightened. Cutters *E* in the rotary cutter-head are furnished with adjustment, so that they may be set to mill the bar down to exactly the required diameter. After passing through the cutter-head, the turned portion of bar *A* is supported by a steadyrest *G* before entering chuck *H* which is provided with serrated rollers that grip the work in a way which effectually prevents it from turning in the chuck, although these rollers offer no resistance to the uniform feeding of the work through chuck *H*.

After the bar has passed through the chuck, the turned end is next fed between three thread milling cutters *J* that take a roughing cut, after which it passes on between three similar cutters *K* which perform the finish thread milling operation. Only two cutters *J* and two cutters *K* are shown in the illustration, although three cutters are actually provided for milling a triple-threaded screw. After the work has progressed sufficiently, the threaded section at this end may be engaged by two accurate half-nuts *L*, which are held in a fixed bracket on the machine, their function being to control the lead of the thread milled in the work from the time that the half-nuts engage the thread. It will be evident from the preceding description that up to the present time, the operation of this machine has required a combined rotary and lateral feed motion for the work, and both of these movements are furnished by chuck *C* until such time as the threaded end of the work is engaged by the half-nuts *L*. It will, of course, be apparent that rotation of chuck *C* is provided by a worm drive *O*, while lateral feed motion of

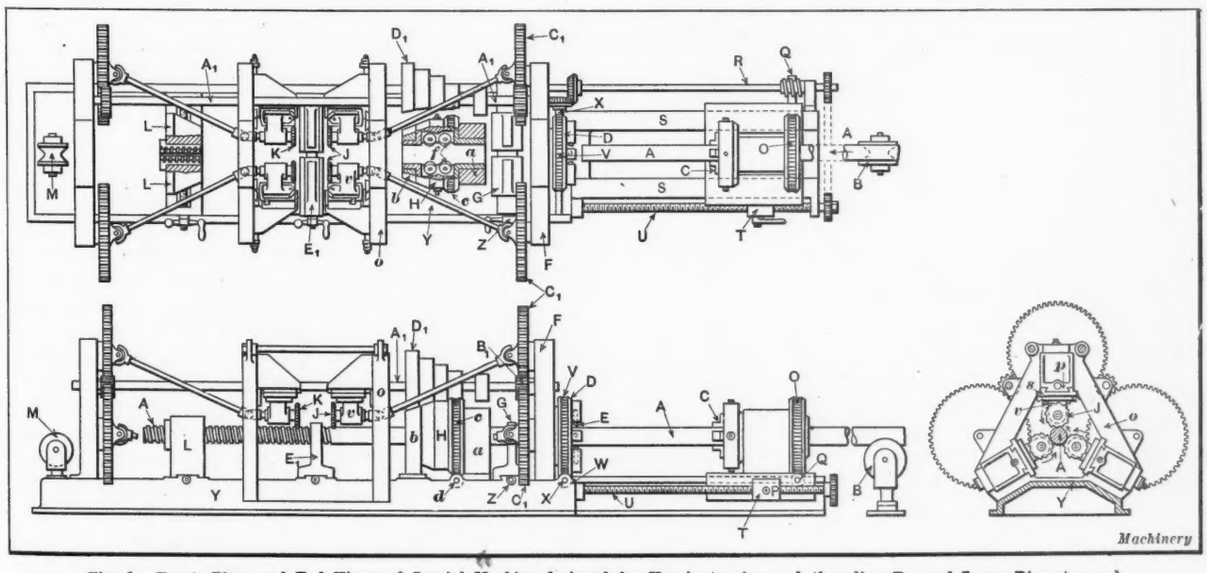


Fig. 1. Front, Plan, and End Views of Special Machine designed for Use in turning and threading Bars of Large Diameter and Indeterminate Length

the chuck is provided by a lead-screw *U* which traverses the carriage on which chuck *C* is mounted.

When the work is engaged by half-nuts *L*, the next step is to release chuck *C*, because from this time on the lateral feed movement and consequent lead of the thread milled in the work is controlled by the half-nuts, while rotary movement of the work is controlled by chuck *H* and the serrated rollers provided in this chuck. Obviously, chuck *H* plays little part in the operation of the machine until chuck *C* is released. After passing through half-nuts *L*, the work runs over roller supports *M* which are provided for that purpose. With a machine of this type it is entirely feasible to mill threads in work of any diameter or length; and single-, double-, triple- or quadruple-threaded screws of any required pitch could be cut by providing a suitable arrangement of roughing and finishing cutters *J* and *K* and half-nuts *L* of the required pitch. It will be seen from Fig. 2 that suitable adjustment is provided, both laterally and vertically, to bring cutters *J* and *K* into position for cutting screws of various diameters and threads of any pitch; it is also necessary to make an angular setting of the cutters corresponding to the helix angle of the threads.

Any usual form of chuck may be used at *C*. This chuck is carried on a large hollow spindle at the rear end of which there is a worm-gear *O* that is slowly driven by a worm on the cross-shaft *Q*, which meshes with the worm on shaft *R*. The base of the chuck is mounted on a slide on the ways of the machine bed, and is provided at one side with a split nut *T* which may be engaged or disengaged from feed-screw *U* that is driven from shaft *R* through a train of intermediate gears indicated by dotted lines at the right-hand end of the machine in the plan view. This gearing is designed to give comparatively slow rotation and a comparatively fast rate of feed to the work. The details will, of course, be governed by the character of the thread cutting operation which is to be performed. Cutter-head *D* is driven by means of a worm-gear *V* which receives power from worm *W* on a cross-shaft *X* that is driven by bevel gears from shaft *R*. This gearing is designed to give a comparatively fast speed of rotation and to take a comparatively fine turning cut. Steadyrest *G* has jaws that form a bearing through which the work can pass with a free longitudinal and rotary movement. This steadyrest is of the usual form arranged with the customary adjustment of the jaws in order that their fit on the work may be regulated.

Chuck *H* is mounted on bearing blocks *a* and *b*, carried on the bed of the machine. This chuck is furnished with a worm-gear *c* which meshes with a worm carried on cross-shaft *d* to provide for driving the chuck at the same speed as the preliminary feed-chuck *C*. It is important to note, however, that chuck *H* is secured against longitudinal movement and is especially designed to permit the work to move freely through it. The best idea of this mechanism will be obtained from Fig. 3, where it will be seen that the chuck is divided transversely with a space between the two parts which are held together by bolts *e*. In this space there are located sharp-edged rollers *f* which grip work *A* and cause it to rotate with the chuck without slippage. It will be seen that rollers *f* are mounted on studs *g* which are carried in bearing blocks *h*, arranged to slide radially in the chuck casing. Each block *h* carries a nut *j* which is engaged by a screw *k*, the outer end of which is squared to provide for turning it as required to obtain the necessary adjustment of the chuck jaws. Each screw *k* carries a pinion *m* which engages a common annular gear *n* so that by turning one of the screws *l* an identical movement is imparted to all of the other screws and to the rollers *f* which engage the work. In this way, the radial position of all the rollers is maintained constant.

In operation, the thread milling cutters are set at a slight angle to correspond with the helix angles of the threads to be milled. In Fig. 1, however, the cutters are shown at right angles to the axis of the work in order to simplify the illustration. For cutting a single thread, these cutters are located one ahead of the other, but for milling a triple thread, as illustrated, the centers of the cutters are in the same plane, with each cutter set at the required angle to the work. In order to adapt the machine for the necessary variations in the work, the cutters are made adjustable, as previously stated, in a radial direction, to provide for different diameters and various depths of cut; in an angular direction, to provide for different helix angles of the threads; and longitudinally, to provide for threads of different pitch.

There are three rough-milling cutters *J* which are uniformly spaced at angles of 120 degrees around the work. The method of mounting the cutters to permit the desired adjustments is clearly shown in Figs. 1 and 2, where it will be seen that a triangular frame *o* is secured to the base of the machine and that the cutters are mounted in carriages which can be moved in radial grooves in this frame. Carriage *p*, Fig. 2, is adjustable on a dovetailed guide on frame *o* to provide radial adjustment of the cutters. Attached to the carriage is a nut *q* through which passes screw *r*, the head of which is squared so that it may be turned to adjust the carriage and cutter to the required radial position for the diameter of the work. Carriage *p* has a longitudinal guiding rib on its upper surface, on which there slides a second carriage *s* provided with a nut *t* and screw *u* which can be turned by its squared end to adjust the longitudinal position of carriage *s* and of the cutter for the pitch of the thread. Bearing block *v* through which the cutter-spindle passes is carried by a central pivot *w* set in the longitudinal carriage *s*. This bearing block has an annular groove at its rear end, in which there slides a bolt *y* that provides for clamping the carriage and the cutter in any angular position required by the helix angle of the thread.

Provision is made for driving each cutter-spindle *z* by means

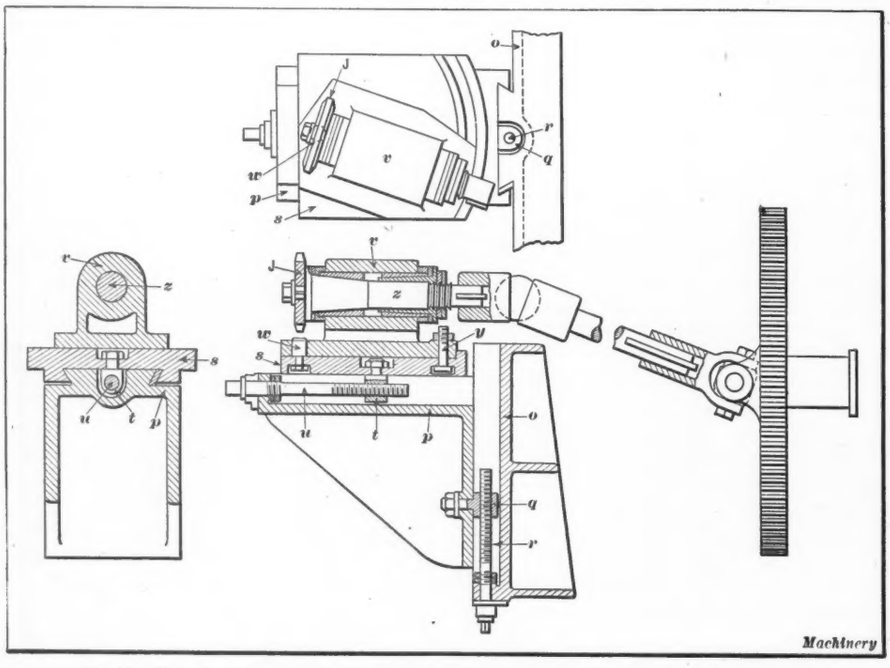


Fig. 2. Method of driving Cutters and Adjustments provided for setting Cutters to meet Requirements of Work

of a shaft with universal joints, which afford a certain amount of longitudinal play to the spindle and permit of making the necessary adjustments of the cutter. It will be seen in Fig. 1 that the opposite end of this jointed shaft is connected to the hub of the gear mounted on bearing block *F*. Two of these gears are driven by pinions on shaft A_1 at one side of the machine, and the third gear is driven at the same speed as the other two by means of an intermediate pinion B_1 on a shaft at the other side of the machine. In operating a machine of this type, it is desirable to have chuck *H* drive the work from a point as near the milling cutters as possible. To provide for obtaining this condition, the universal jointed shafts that drive the cutters diverge from the rear ends of the cutter-spindles to gears C_1 located behind chuck *H*. The forward end of this chuck is also tapered to provide for bringing it even closer to the cutters than would otherwise be possible. The main driving shaft of the machine A_1 receives power from a belt running over cone pulley D_1. All mechanisms on the machine obtain their motion from this shaft.

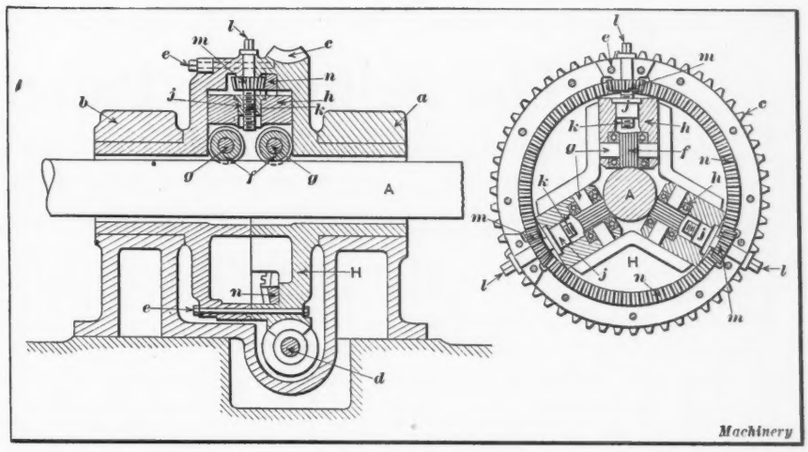


Fig. 3. Special Chuck which rotates the Work but allows a Continuous Feeding Movement

Located between the roughing cutters *J* and the finishing cutters *K* there is a second steadyrest E_1, similar in design to the one shown at *G*. This steadyrest is mounted on the bed of the machine, and its jaws are adjusted by a screw operated by the ball-crank shown in the illustration. The finishing cutters *K* are mounted in bearing blocks carried on a frame fixed to the machine bed, and these cutters are provided with the same adjustments as have already been described in connection with the roughing cutters. The spindles of the finishing cutters are also driven by universal jointed rods attached to the hubs of three gears arranged in essentially the same form as those for driving the roughing cutters. The lead-nut *L* is in two halves, which are tapered at the front to permit the nut to be set between the universal jointed shafts at a point as near as possible to the finishing cutters. The two halves of the lead-nut are mounted on a dovetailed guide on the base of the machine, and are adjusted toward or away from each other to provide for clamping or releasing the work, by means of a transverse screw operated by a ball-crank.

It is quite general practice to make large screws of considerable length by piecing together the required number of short sections, but where this is done difficulty is often experienced in securing a perfectly accurate continuation of the thread across the joints. Where the present method of machining is employed, the thread is produced at one continuous operation and it is claimed that greater accuracy can be obtained. The first part of the thread, which is milled with the work secured in chuck *C*, can be made very accurate, and this governs the accuracy of the remainder of the thread. Attention is called to the importance of locating the feed-nut which engages the thread in the work as close to the milling cutters as possible, in order to avoid any tendency for the machine members to spring. This assures having the initial portion of the thread present the minimum variation from absolute accuracy. Similarly, it is important for the milling cutters to be located as close as possible to chuck *H*, in order to reduce to a minimum the total distance to the feed-nut and to hold the work with a minimum amount of torsion. After chuck *C* has been released, the rotation of the work is accomplished by means of chuck *H*; and in order to cut down the amount of turning force that must be exerted by this chuck, the direction of rotation of cutter-head *D* and of thread milling cutters *J* and *K* are opposed to each other, thus requiring a comparatively light turning effort from the chuck, because the only force necessary is that required to turn the work plus the difference in resistance offered by the thread milling cutters and by the cutter-head which turns the surface of the bar.

In designing a machine of this type, the rotary cutter-head *D* for turning the surface of the bar is not really essential, as a rod turned to accurate form may be threaded without using the turning tools in cutter-head *D*. Obviously, a machine could be built for doing work of this kind without providing a turning head; but the use of such a head is desirable because it forms the rod to a true cylinder with its axis correctly aligned for the threading operation. In turning a long rod, the turning tools may become dull and have to be renewed before the end of the operation. Provision is made for meeting such an emergency without stopping the work. For this purpose, the turning head is provided with adjustment along the ways, and is started in its extreme backward position. Then when it becomes necessary to change tools, this is done and the cutter-head is moved forward to a point ahead of the advanced position of the end of the section of the bar already turned, so that with the cutters accurately set the operation will be continued when the unturned section of the bar has progressed to a point where it again engages the cutters. When so required, the first part of the thread at the front end of the bar may be formed by some other method than that provided on the machine under discussion. For instance, a separate short rod with the desired form of thread could be joined to the end of the work and engaged by the feed-nut to draw the front end of the work through the thread milling cutter and finally through the feed-nut, thus duplicating the model thread on the work. Various other modifications of the machine and methods of employing it could be made to meet the requirements of special cases.

* * *

DEPOSITS OF TUNGSTEN ORE

An extract, taken from the *London Statist* and published in the *United States Commerce Reports*, says that Burma was, until 1916, the largest producer of wolfram, the principal ore of tungsten. Though possessing the richest tungsten-ore deposits in the world, Burma has been handicapped by crude methods of mining and treatment of the ore and by primitive means of transportation. The keen demand for tungsten led to a remarkable display of energy in the United States in prospecting for new occurrences of ore and in developing existing deposits here. The result is that the United States has outstripped Burma in ore production during the last two years, and has also become a considerable exporter of tungsten metal and ferro-tungsten alloy to steel-manufacturing countries. Large increases in ore output have also taken place in Japan, in Portugal, and in Argentina, Bolivia, and Peru. Stimulated by high prices, the mining of these ores in the three last-named countries has rapidly developed during the past three years, the output being shipped chiefly to the United States.[8] Australia is second in importance among British territories producing tungsten ores.

The Selling of Patent Rights

Different Methods by which an Inventor May Obtain Satisfactory Returns from a Patent

BY FORD W. HARRIS

THERE may be said to be three steps in the process of putting a patented article on the market, namely, inventing the article, securing a patent on it, and organizing a company with the financial means required for its manufacture. A great deal has been written about the first two steps, but very little information has been published about the third, which is the subject now to be considered.

Let us assume that the inventor has an invention of real practical value, and that he has a patent on it and is ready to place the invention on the market. How should he proceed to interest manufacturers or capitalists, and what kind of trade should he expect to make? This is a question that the patentee usually faces and one to which no universal answer can be made. The market for an invention depends on what the invention is; and what applies to one kind of patent decidedly will not apply to another. However, there are a few rules which apply to all inventions.

Patent Selling Agencies

Every inventor receives immediately upon the issue of his patent, many circulars from concerns that pretend to be engaged in the business of selling patents. If they are investigated it will be found that they one and all want a fee in advance. It may be two dollars or it may be several hundred, but the fee is the first subject they broach. Sometimes the fee is for a write-up, sometimes it is for a cut of the invention, and other times it is for advertising matter, but the main principle is that you pay them some money and they do some work. They will not guarantee to sell your patent nor will they make the original fee contingent on a sale. So far as the writer has been able to determine, all these concerns are failures in so far as getting results is concerned. They take the fee and do about what they advertise to do, but they rarely make a sale. The reasons for this are more or less obvious.

Interesting the Manufacturer

One reason is that nearly every patent has a limited number of possible buyers. Manufacturers are rarely hunting for inventions to develop. They are engaged in making a certain product, and if you go to them you must show them something that they need in their business. In general, it must relate in some way to the thing they are making. It must be of such a nature that their sales force can handle it, and it must be of such a nature that the factory can readily turn it out with the tools and other machinery on hand. If you are going to sell to an established manufacturer you have two problems—first, to find someone who can handle the invention, and second, to interest him when you do find him.

It has been the writer's experience that it is a very difficult matter to attract a man's attention by corresponding with him. A great deal has been written about sales letters, but the only really successful way to sell anything that requires actual salesmanship is to see the prospect, and tell him the truth in such a way that he will believe it. Consequently, form letters scattered broadcast to several hundred manufacturers are usually barren of results. Few business men read letters that do not relate to something they are interested in. If they know the man who wrote the letter, or if they are already interested in the subject, a letter receives attention, but new matters do not receive much attention when presented by mail, and certainly will not obtain a hearing if they come in an unsealed envelope with all the other marks of a form letter. Sending out form letters is about all the so-called "patent brokers" do, and the inventor can do just as well himself at much less cost. The writer's advice, however, would be, to save the postage; and in any case to avoid patent brokers or unknown persons who wish to handle the sales of your invention.

Ascertaining the Value of Patents

Before submitting the patent to a manufacturer, or indeed before doing anything at all with it, it is wise to find out just how broad a field it covers. It must be understood that a patent consists of two parts, namely, a description, accompanied usually by a drawing which tells the public how to use the invention, and one or more claims that state just what part of the article described cannot be used without paying royalty to the inventor. So far as discriminating buyers are concerned, the patent resides wholly in the claims, and many patents have narrow or even worthless claims. The patent should be taken to a patent attorney, and a full explanation obtained from him as to the scope and effect of the claims that he has obtained for the inventor. Bear in mind that a claim is an exact description of the thing another person cannot make without infringing on a patent, and that anything that the claim does not describe will not be an infringement. The shorter the claim the better; and the fewer the elements and the more broadly they are stated, the better the patent.

It is desirable to find out positively just how good a patent is before trying to sell it, as this is the first thing a manufacturer wants to know, and he will usually take it to his patent attorney and ask his opinion of it before giving it serious consideration. It is therefore useless to expect to interest any wise manufacturer in a patent that has narrow or worthless claims, and it is surprising how many such patents are granted. After having obtained the opinion of the attorney who secured the patent, it is wise to have some other good patent attorney look at it and obtain his opinion. Such an opinion may save a great deal of hard work and expense. Many an inventor wonders why he is unable to interest capital, when the whole trouble is that his patent will not bear even a casual inspection by an expert. The first rule in trying to sell a patent is to make sure that the inventor has a patent of value to sell.

Salesmanship Required in Selling Patents

Having the patent to sell, there are really two courses to be followed unless, of course, one happens to be so fortunate as to have the money to go ahead himself without asking for financial help. One is to interest a manufacturer, and the other is to interest capital to finance the manufacture. To interest the manufacturer, it is first necessary to find the man who is able to handle it. If it concerns a certain line of business, it will pay to study that line a little if one is not already familiar with it, in order to determine who are the principal concerns interested in that particular line. Pick out a man who has a good reputation and ask for an interview. In talking to a manufacturer, or indeed in trying to sell an invention to anyone, try to leave as little to the imagination of the buyer as possible. In other words, if you are trying to sell a patent on a carburetor, have a real carburetor ready to show him; do not expect him to take your word that it will work as you say it will. Have it ready to put on a machine and demonstrate. Also, do not

leave off important parts or submit a rough model and expect to obtain a good hearing.

The more complete and thoroughly worked out the invention is, the more likely is the prospect to be interested. Also, the more tangible and material things that are exhibited, the easier it is to sell. For example, you may well have snapshots showing how the invention works or how it is installed; you may have letters from prospective customers; or, better yet, you may have actual or contingent orders for the device. Or, again, you may have a letter from your patent attorney advising you that you have a good patent and one that will prevent others from making certain classes of devices, and to supplement it you might show a letter from an entirely independent attorney saying much the same thing.

Now you may not be an experienced salesman, but if you are an inventor you have one thing that makes up for lack of experience in salesmanship, and that is the fact that you understand your invention and have faith in it. That is the first essential to selling anything, and it is a convincing factor. If you have picked the right man and your invention has real merit you will be able to interest him. If you cannot interest him, assume that he is not the right man and try another. It may be necessary to try several times before you locate the right man. Try to find out, however, why each prospect turns you down, as his reason for rejection will give you a line on how to overcome the same objection if another person raises it, and will also show you whom to approach next.

Different Plans of Selling Patent Rights

Having found your man, what sort of trade can you make with him? Here, again, only general rules can be given. You can sell the invention outright or you can place it on a royalty. Many concerns will not pay royalty, preferring to figure out carefully just what the invention will probably be worth to them and either buying it outright or rejecting it. Others prefer to pay royalty.

If it is a matter of a cash sale, there are only two rules for selling anything, namely, get as much as you can and do not be too greedy. The latter rule applies with peculiar force to inventors who see only the millions that may be made. It is well to seek unbiased and expert advice as to values. If you have friends who have good business judgment, try to get them to figure out what the invention ought to be worth to the particular manufacturer you are dealing with. Try to estimate the probable market and the profits, but do not let your imagination run away with you. While it is true that there are many poor inventors who sold too cheap, it is also true that there are ten times as many who never sold at all because they were too greedy.

If you have a prospect that wants to take the patent on a royalty basis, see that he agrees to pay a minimum royalty. That is, see that he agrees to pay you a certain sum every year or every three months or six months whether he makes and sells any or not. Also see that he recognizes the validity and utility of your patent and that he agrees to pay his royalty on or before a certain day. If the royalty period is one year, it is well to make the contract for only one year and make it automatically renewable if the minimum royalty is paid and the other conditions lived up to. Then you do not have to take anything away from him—he simply does not renew his rights. The whole object of minimum royalty is to prevent anyone from taking over the invention and not working it. Sometimes a man wants to keep an invention out of the market, and by agreeing to pay royalty on any of the articles that he makes and then not making any, he will succeed in shelving the invention. Consequently, the minimum royalty should be just big enough to prevent such shelving. For example, if the buyer of the patent rights is in the business of making a competing article, the minimum royalty should be so big that he cannot afford to sidetrack the invention. In other words, it should be a large part of his profits from the competing device.

Basis on Which Royalty Contracts Should be Made

Royalty contracts are usually made on a basis of a certain per cent of the retail selling price, or in some cases on a percentage of the price obtained by the manufacturer. A much better arrangement is an agreed amount per article. In some cases the inventor agrees to take a certain proportion of the profits. This is usually a very poor arrangement, as the inventor is in effect and usually in fact a partner, and may become liable for the debts of the business; and in any case he has to find out what the profits are, which is often a matter for much argument and contention. The manufacturer should agree to keep an accurate account of the number of articles sold and to report and remit at stated times. He should also agree to allow the inventor free access to his books during business hours, and should agree to swear to the correctness of the books and the reports if required to do so by the inventor.

Sometimes it is possible to give the articles consecutive serial numbers, which makes the accounting easier, and sometimes the inventor furnishes nameplates or labels at so much apiece, which the licensee affixes to the article. It would seem at first sight that the collecting of royalties would be a difficult matter, but with a properly drawn contract it is just as easy to keep track of and collect royalties as it is to collect any other debt. The royalty contract should be drawn by a patent attorney who is experienced in such matters. The main considerations are to see that the contract is definite as to what is to be done, and the exact time that it is to be done, and to provide that if it is not done, all rights shall revert to the inventor. This requires some knowledge of state law, and the patent attorney should also be an attorney-at-law, admitted to practice in the state in which the contract is made.

The Territorial-right Plan of Selling Patents

The character of some inventions makes it difficult to sell them outright or place the invention on a royalty. Some inventions can be handled on the territorial-right plan. For example, patents on road or concrete construction readily lend themselves to this plan. It is possible, with inventions of this kind, to sell state or county rights, and some inventions can be sold for even smaller territory. This plan proves profitable in many cases, as there are a great many counties, for example, in the United States, and a small amount per county will aggregate a surprisingly large sum. In these cases, the inventor sells the entire and exclusive right to make, use, and sell the invention within a specified territory. In other cases, a mere shop right may be granted, or rights may be sold which are not exclusive. There is one great advantage with the latter course, and that is that where an inventor is willing to license all manufacturers to make and sell the invention, and where he is satisfied with a small royalty, there is not much incentive for any manufacturer to infringe. In fact, it may be said to be a general business policy to grant licenses to all comers upon a small royalty, if the licensee agrees to maintain prices. Usually where a number of competing manufacturers are willing to enter into such an agreement it is found to be very profitable, as they are able to raise the price of their product a sufficient amount to more than pay the small royalty demanded. Such agreements are of doubtful legality, but there are a number of industries in which it is common practice.

Possible Infringement on Previous Patents

The inventor often is unable to interest a manufacturer, and it is necessary for him to actually embark in the business of making and selling his invention. If he has the money, there is nothing to mark such a business venture from other lines of business unless it be the hazards which are peculiar to patents. For example, most men believe that if they have a patent, they are free to go ahead and make the thing patented. In other words, they regard the patent as a license to make and sell the thing described in the

patent. This is a mistake that has cost many a man all he had. It is entirely possible, and even very common, for a man to have a patent on a thing that he cannot make without infringing on patents owned by others. This is due to the fact that his patent is a narrow one covering an improvement on something to which another holds broader or dominating patents.

Before plunging into any business involving patent rights, an investigation should be made to determine what other patents there are that would interfere. This again is the business of the patent attorney. Sometimes earlier and broader patents are found that apparently debar one from entering the field; but it is often the case that these patents have been taken into court and declared invalid, or the facts surrounding their issue and the state of the art at the time of their issue are such that they stand an excellent chance of being declared invalid if they are taken into court. If the business promises to be profitable, it ordinarily pays to have an investigation made as to the validity of such earlier patents before abandoning the hope of success. Here again the patent attorney can be of material assistance. He will go to the files and investigate the scope and validity of the earlier patents and can probably tell what the chances are of losing a law suit if one is started against you.

Before going into the business of making and selling an invention, all such legal questions should be settled as well as the probable market and possible price. If you are sure that it is legal to make the thing and that there is a market with a probable good margin of profit you are justified in organizing your business. It is not really so important to have a broad patent yourself as to be sure that you are not going to infringe some other fellow's patent; but it is wise, before you start, to assure yourself that your patent is going to keep others out of the field when you get it developed. It is also wise to keep your patent attorney informed as to your progress and to file new applications as fast as new ideas occur to you that may be legitimately patented. Most successful businesses will warrant several patents.

Concluding Remarks on the Selling of Patents

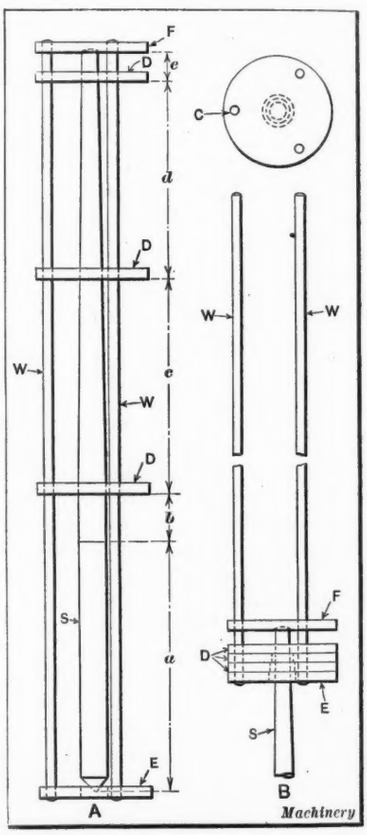
Sometimes, and indeed in the majority of the cases, it is necessary for the inventor to seek financial help elsewhere before he can start in the business of exploiting the patent. Considering the proposition purely from the standpoint of the inventor seeking capital to exploit a genuine invention, several things may be said. In the first place, it is advisable to carry the work of perfecting the invention as far as possible with one's own resources. For example, you have an idea for which you have not applied for a patent. It is very hard to induce anyone to invest money on a mere idea, and even when they do, they will ordinarily want a half interest. If you have spent your own money in applying for a patent you have shown your own faith in the idea to that extent, and you are in a better position to trade. If your patent has been allowed, you are in a still better position. If you are able to exploit the invention, yourself, even in a very small way, so that the probable cost, margin of profit and demand can be shown, you are in a still better position to deal with capital. In other words, the further you develop an invention yourself, the easier it is to interest others.

Further, it is much easier to get a partner than it is to sell for cash. If you have an invention and want to sell it for $10,000 you will find it much harder than it is to get some man to put the same amount in the business for a half interest. In the former case, he figures that you are anxious to get out, and becomes suspicious; in the other, he considers that you must have faith in the invention, since you are trying to retain a half interest. If it is a real invention, it is always worth more than you can legitimately get for it, and it is wise to retain it until it is on the market, when you can usually find some concern or man who is in a position to handle it to good advantage and who will pay a satisfactory price.

GAGE FOR GRINDING TAPER SPINDLES

Spindles such as shown at *S* in the accompanying illustration are used on textile spinning frames for carrying bobbins, and must be accurately ground. The taper at the top of the spindle must be ground to fit the bore of the bobbin precisely. The spindles run at a rotative velocity of from 3000 to 5000 revolutions per minute; therefore the center of gravity of the spindle must coincide with its axis in order that a revolving balance without any perceptible vibration may obtain.

The gage shown in the illustration is used to gage the ground tapered top. It consists of several hardened and ground steel rings *D*, the number depending upon the length of the spindle and the number of measurements required to assure an absolutely straight taper. Usually three such gage rings are sufficient for the purpose. These rings have straight holes for gaging the spindle at various diameters, which are finished to the required sizes. The three holes *C* are also drilled in the rings *D* so that the latter will slip freely on the wires *W* when assembled as shown. These wires are headed over on the ends, or some similar precaution is taken, so that the ends *E* and *F* will be prevented from coming off and the gage from becoming disassembled. The gage is shown at *A* as it appears when in the gaging position. Assuming that the diameter at the small end of the spindle is 0.1875 inch and that the taper is 0.021 inch per inch of length, then the diameter at the distance *e* from the end can be calculated, and the gaging hole in the first gage ring is made accordingly. The sizes of the holes for the remaining rings would then be determined in a similar manner, taking particular care that the ring which gages the diameter at the beginning of the taper, that is, the lower ring, does not slip down below distance $a + b$ from the lower end of the spindle. If, for example, the distances *e*, *d*, and *c* are assumed to be ½, 2⅝ and 2⅞ inches, respectively, then using the same taper and the same diameter at the small end as assumed above, the ring holes would be lapped to 0.198, 0.253, and 0.3135 inch in diameter and assembled onto the wires in the order named.



Gage used for determining the Taper of Ground Spinning Spindles

At *B* the gage is shown as it would appear collapsed when not in use. The spindle is inserted through a hole in the base *E*, pushing the end *F* upward. As the spindle is advanced toward the top, each gage ring seats itself on the taper and, if the spindle is correctly ground, at the predetermined distances from the end. These distances are marked on the wires and the operator can thus determine at a glance whether or not the proper taper is being obtained. The same wires and ends can be used on different styles of spindles and, when the taper will permit, the same gage rings can also be used (if wires of corresponding length are employed) by re-marking the gaging distances. F. R. D.

SAFETY RULES FOR OXY-ACETYLENE WELDING

The following rules have been adopted by the Western Pennsylvania Division of the National Safety Council, and may well be observed by all who are engaged in oxy-acetylene welding or cutting operations, and the transportation or care of oxygen and hydrogen tanks.

Equipment

1. All pressure tanks should be fitted with safety relief devices, and tanks not so equipped should not be used.

2. The equipment should include a high-pressure gage to indicate the pressure on the tank, a reducing valve, and a low-pressure gage to indicate the pressure on the torch. These should be assembled as one unit and so arranged that they need not be separated when they are attached to, or detached from, the tank. The two gages should have different-sized openings; one should have a right-hand thread and the other a left-hand thread so that they cannot be interchanged. There should be one of these units for the oxygen tank and one for the acetylene tank.

3. All pressure regulators should be equipped with a safety relief valve which will relieve the pressure from the diaphragm and low-pressure gage in case the high-pressure valve should develop a leak.

4. Wire-wrapped hose should not be used.

5. The oxygen and acetylene hose should be of different color or the couplings should be stamped for identification purposes, so as to avoid interchanging the hose.

6. The torches should be of a type which will not backfire.

Rules for Operation

1. Under no condition should acetylene be used where the pressure is greater than fifteen pounds per square inch.

2. Special care should be given to the storage of oxygen and acetylene tanks. Acetylene is classed as an explosive, and only a limited number of containers should be stored in any one place. Oxygen tanks should be stored in a separate place from acetylene tanks.

3. Oxygen and acetylene tanks should not be allowed to remain near stoves, furnaces, steam heaters or other sources of heat, and should not be exposed unnecessarily to the direct rays of the sun, as an increase in the temperature of the gas will cause a corresponding increase in the pressure within the tank. Any excess of heat may also soften the fusible safety disk with which the tank is provided, causing it to blow out and permitting the gas to escape.

4. Oxygen tanks should never be handled on the same platform with oil or grease which might find their way into the valves on the tanks.

5. Oxygen and acetylene tanks should never be dropped nor handled roughly and should never be stood on end unless fastened so as to prevent them from falling over.

6. Tanks should not be handled by crane, either magnetic or mechanical.

7. All empty tanks should be marked plainly with the word "empty" and returned promptly to the store-room.

8. An open flame should never be used for the purpose of discovering leaks in acetylene tanks. Leaks can generally be detected by the odor of the acetylene gas, and their location can be determined by applying soapy water to the surface of the tank and watching for the soapy bubbles formed by the escaping gas.

9. No repairs to oxygen or acetylene tanks or equipment should be made or attempted. All defects should be reported promptly to the foreman, and by him to the manufacturer.

10. Leaking acetylene tanks should not be used, but should be placed in the open air and all open lights kept away from them. All leaking acetylene tanks should be reported promptly to the foreman and immediately returned to the manufacturer.

11. All open flames should be kept away from any place where there is any possibility of acetylene escaping.

12. Care should be taken to protect the discharge valves of tanks from being bumped, as a jar may damage the valve and cause it to leak.

13. Grease in contact with oxygen under pressure may cause spontaneous ignition. Great care should be taken not to handle threads or valves with oily hands or gloves, and gages should not be tested with oil or any other hazardous carbon. If a lubricant must be used, the purest glycerine is permissible.

14. Gages, apparatus, and torches requiring repairs should be sent to the manufacturer, and local repairs should not be attempted. Valve seats should never be replaced except by the manufacturer.

15. The use and operation of the pressure regulator or reducing valve on oxygen or acetylene tanks should be as follows:

a. Open the discharge valve on the tank slightly for a moment and then close it. This is to blow out of the valve any dust or dirt that might otherwise enter the regulator.

b. By means of the stud or nut connection on the regulator, connect the regulator to the discharge opening of the tank.

c. Release the pressure adjusting screw of the regulator to its limit.

d, Open the needle valve slightly if there is one.

e. Open the discharge valve on the tank gradually to its full width.

f. Open the needle valve to its maximum if there is one.

g. Adjust the pressure regulating screw until the desired pressure is shown on the low-pressure gage.

16. The discharge valves on the tanks should be opened slowly, and care should be taken to avoid straining or damaging them by the use of a hammer or the wrong kind of wrench. A special wrench should be made for use in opening these valves in case they stick.

17. When the operation of the cutting or welding torch is stopped for a short time, the needle valve on the regulator should be closed, or the pressure-adjusting screw should be released to keep the pressure off the hose. The torches should be opened momentarily to let the pressure out of the hose lines.

18. All tanks should be inspected at the close of the day's work.

19. Proper precautions should be taken to protect the hose from flying sparks.

20. All hose should be examined periodically at least once every week. This should be done by cutting the hose off at the end of the connection and examining it. In addition, after a few months' use, the hose should be cut off about two inches back of the connection and examined for defects. A defective hose should never be used.

21. Special care should be taken to avoid the interchange of oxygen and acetylene hose or piping, as this might result in a mixture of these gases that would be highly explosive. The practice of using right- and left-hand threads is recommended.

22. White lead, grease, or other similar substances should never be used for making tight joints. All joints and leaks in equipment should be made tight by soldering or brazing.

23. The oxygen and acetylene valves at the base of the torch should be tested daily for leaks.

24. Where hydrogen or other gas is used instead of acetylene, the same precautions should be observed as for acetylene.

25. A fire extinguisher should be carried as regular equipment to be used in case of fire.

26. Men using welding apparatus should wear suitable welding goggles for eye protection, having frames that are non-conductors of heat (not celluloid), side shields to protect against hot particles of metal, and lenses of proper color.

27. Operator's clothing should be fireproof.

28. If valves become frozen, they should be thawed by hot water, not by flame or hot metal rod.

29. Homemade generators should never be used, as they are unsafe. Only generators permitted by the Board of Underwriters should be used.

30. Where acetylene is used from generators or is piped through the plant, an approved water seal should be interposed between the generator and the piping system, and individual water seals should be placed at each blow-pipe.

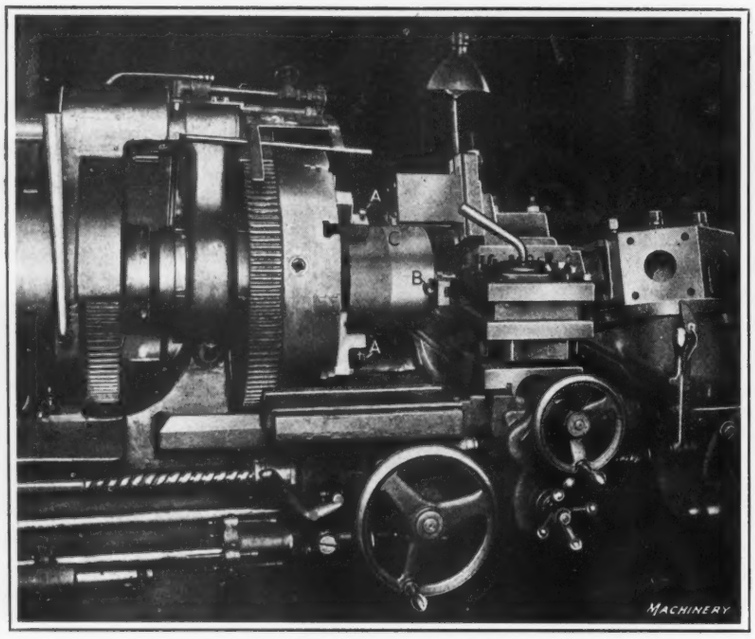


Fig. 1. Front View of Gisholt Lathe set up for performing First Step in Pulley Crowning Operation

Water seals should be inspected daily without fail.

31. Portable generators should not be used inside the building.

32. Safety devices on tanks, generators, or apparatus should not be removed or tampered with.

33. In welding brass or bronze, injurious fumes may be given off, making it desirable to wear a respirator.

34. Smoking while on duty should be prohibited.

35. Electric lights in a generator house should be enclosed in vapor-tight globes protected by the regulator guard.

36. Snap switches should be placed outside of the generator house in a suitable place, provided the house is isolated.

37. Piping which is used to carry acetylene or hydrogen should be painted a distinctive color.

38. The manufacturers should provide couplings for the hose which cannot be mistaken and put on the wrong hose. If the couplings could be made with proper connections, it would be impossible to make any mistake.

39. In storage houses where hydrogen or acetylene tanks are stored, the wiring should conform to the same rules as for the generator house, so that an explosion could not be caused by defective wiring or a break in the bulb.

40. The valves on the piping should contain neither copper, brass, nor bronze.

41. In opening the outlet valve of a full tank, do not remove the regulator.

42. The operator should not stand in front of the gages when opening the discharge valves on the tank. If the pressure goes off suddenly, it may possibly destroy the gage, and the glass and parts will be blown out at the front.

43. A label should be placed on every tank of oxygen, stating that it should be kept away from grease.

CROWNING PULLEYS ON A GISHOLT LATHE

At the plant of the Robbins & Myers Co., in Springfield, Ohio, very satisfactory results are obtained in the performance of pulley crowning operations on a 24-inch turret lathe built by the Gisholt Machine Co. of Madison, Wis. The taper attachment of the lathe is relied upon to obtain the necessary crown on the pulley, and as shown in the illustrations, the complete job is done in two operations, one half of the face of the pulley being turned at each setting of the work. In addition, the edges of the rim and the ends of the hub are faced, and the hub is bored. Figs. 1 and 2 show front and rear views of the Gisholt turret lathe set up for performing the first operation, and Fig. 3 shows the way in which the work is held for performing the second operation. The pulley shown set up on the machine is a gray iron casting 12 inches in diameter by 8 inches face width, with a bore 1¾ inch in diameter.

In order to obtain satisfactory results in turning these pulleys, it is important to have the work held in such a way that it will not be distorted through pressure applied by the chuck jaws. With this idea in view, special jaws were made, each of which has a lug projecting inside the rim of the pulley, and a screw *A* which projects through another lug on the chuck jaw and engages the outside of the pulley rim. It will be apparent that with such an arrangement, each jaw can be adjusted so that the lugs come lightly into contact with the inside of the rim, after which screws *A* are tightened; and in this way provision is made for holding the work rigidly between the lugs on the inside of the pulley rim and the screws on the outside, without danger of distorting its shape. At the first setting of the work the hub is bored and faced at one end, one edge of the rim is faced, and one half of the pulley surface is rough- and finish-

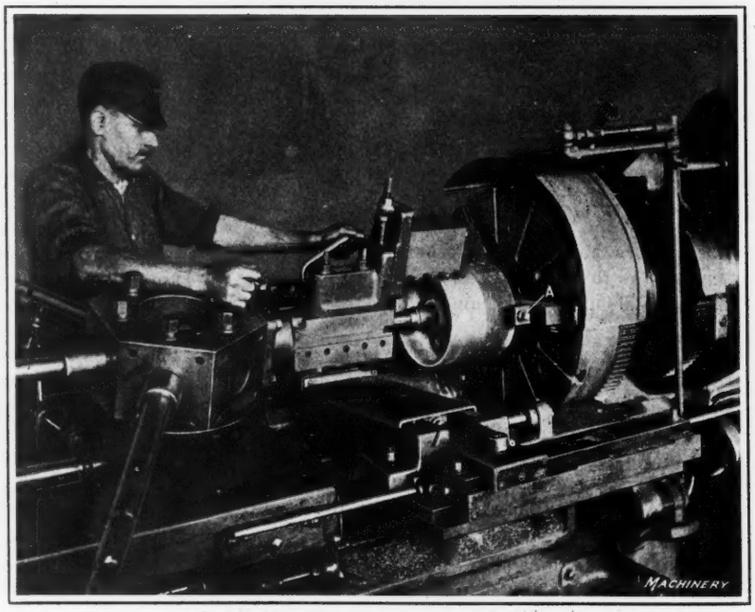


Fig. 2. Opposite Side of Lathe, showing Taper Attachment that forms the Crown on the Pulley

turned. The rough-turning of the pulley surface is done with a single-point tool *B*, which is carried in a turret toolblock on the cross-slide and controlled by the taper attachment of the lathe; and the finish-turning is done with a broad-faced tool *C*, held in the piloted overhanging holder attached to the turret, the pilot entering the bore in the

hub. This tool is set at an angle to give the required crown on the pulley. The facing of the ends of the hub, the boring of the hub, and the facing of the edges of the rim are ordinary turret lathe operations and do not need any description.

For performing the same operations on the other half of these pulleys, the casting is set up as shown in Fig. 3, with special jaws *D* on the chuck, which provide for gripping the turned half of the surface of the pulley without damage; these jaws also distribute the pressure over a sufficient surface of the pulley to avoid danger of distortion. The actual machine work is performed in exactly the same way as for the first operation. The time required to complete all of the machine work on this job is approximately thirty minutes, which is very satisfactory from the standpoint of production. Excellent workmanship is also obtained. The same method is employed for machining various sizes of pulleys which are required for use on electric motors built by the Robbins & Myers Co.

E. K. H.

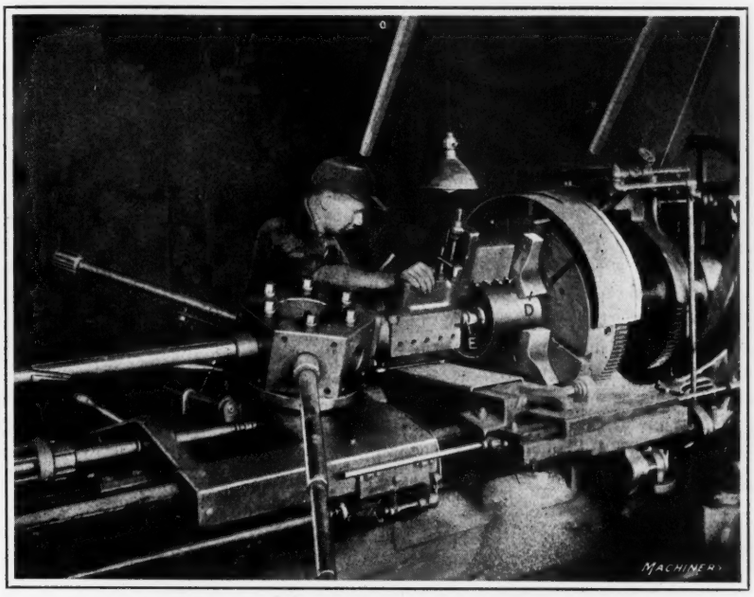


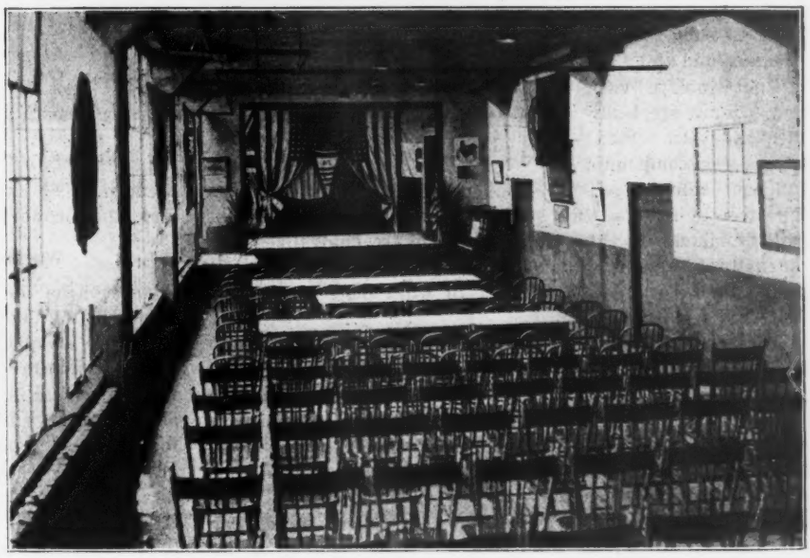
Fig. 3. Rear View of Gisholt Lathe set up for performing Second Step in Pulley Crowning Operation

* * *

WELFARE WORK OF THE PRACTICAL KIND

When a factory is located in a small town where amusements are scarce and where there may not even be so much as a moving picture show, the life of the workers and their families is monotonous and there is a tendency to drift to the larger centers. It then becomes an industrial problem that must be solved to satisfaction, to provide such forms of amusement as are required for a normal existence. This problem has been unusually well solved by a departure made by the Bantam Ball Bearing Co. in Bantam, Conn.

Bantam is a village some twelve miles away from the nearest town where any amusements are available, and the largest industry in the village is that of the Bantam Ball Bearing Co. The necessity of providing a suitable recreation center became apparent to W. S. Rogers, the leading spirit of the company, and his ideas have been worked out in a remarkably satisfactory manner. Within the factory building of the Bantam Ball Bearing Co. itself, a theater, 80 by 25 feet, has been built, having a real stage, first-class moving picture outfit, and a seating capacity for 250 people. Twice a week moving picture performances are given, free to all employes of the company and dependent members of their families, but no outsiders are admitted. It is strictly understood that the privilege of this recreation center is conferred only upon those who are connected with the Bantam Ball Bearing Co. in a working capacity or their dependents.



Interior of Theater established by the Bantam Ball Bearing Co. to provide a Recreation Center for the Employes

Other nights during the week the theater is used for various other purposes as determined by committees of employes. In fact, the whole amusement center is placed in charge of the men, and is run through their various committees. It has proved a valuable addition to the community life and is actually a means toward industrial efficiency, because it stabilizes the working force, brings out the latent capacities of the workers, and gives them new interests, all of which has a decided influence upon their interest in their work, and on the whole, may be said to be a step toward industrial efficiency through the common-sense method of providing the proper kind of recreation. It is practical efforts of this kind that will bring employers and employes closer together and establish that harmony which is so necessary for industrial efficiency. The human factor in industrial management has been overlooked too much in the past. It is gratifying to note that of late there has been a decided revival in the recognition of the human factor, and as its importance is more thoroughly appreciated, industrial difficulties will become less acute.

* * *

VOCATIONAL EDUCATION FOR FOREIGN TRADE

The keen competition in foreign trade and the opening of new foreign markets to American products have found cooperation in courses offered by both the College of the City of New York and by the New York University. These institutions offer a variety of courses covering export technique, which deals with the documents used in export trade; South American sales problems, an advanced course for those familiar with the fundamentals of foreign trade; market of geography, a study of markets and trade channels; United States and foreign customs administrations; foreign credits and financing foreign trade; Russian markets; practical steamship operations; commercial French, Italian, Portuguese, Spanish, and Russian, and business English. A number of other institutions have plans for similar courses.

Rustproofing Steel

Method Used in the Plant of the Hudson Motor Car Co., Detroit, Mich., for Rustproofing Passenger Car Steel Bodies Preparatory to Painting by Means of the Deoxidine Process

IN preparing iron and steel surfaces for painting, many different methods have been developed for removing rust and preventing future rusting. Painting is only a temporary means for preventing iron and steel from rusting, as rust forms on the metal beneath the paint. Consequently some treatment is necessary preparatory to painting to provide a permanent rustproofing coating. A method that has been developed for this purpose is treated of in the following.

Methods Commonly Used in the Past for Preparing Steel for Painting

Three methods, which have been commonly used in the past for preparing steel for painting, and which are still used to a considerable extent are: (1) Washing or scrubbing the steel surface with gasoline or other oil solvent; (2) washing the surface with soda or other alkaline compound; (3) sand-blasting. Each of these methods, however, has certain disadvantages when applied in practice.

Gasoline, or other solvent for oil, mechanically removes the loose particles adhering to the surface to be cleaned, as well as part of the oil, but it does not remove all of the rust that has formed on the steel. Emery cloth may be used in connection with the gasoline for rubbing off the rust, but this treatment merely exposes the steel to the atmosphere, thereby making it likely to rust again rapidly.

Alkaline compounds, such as soda, remove greases and oil, but do not remove rust, and after a steel surface has been treated with a soda compound, sufficient amounts of this compound are generally left on the steel to form a thin strata of soap between the paint and the metal. In this strata, the acids are neutralized, but the salts left behind have strong inclinations to produce rust, and the surface is not left in what may be called a "passive" condition.

The sand-blasting process removes both rust, oil, and grease, because it removes the entire surface of the metal and, hence, all objectionable materials that cause rust; the process, however, is not entirely satisfactory, because it leaves the surface of the steel exposed and the metal, therefore, will rust rapidly. What is required is a method that will produce a surface that has no tendency to rust. The deoxidine process, which is used by the Hudson Motor Car Co., Detroit, Mich., in preparing the steel bodies of its passenger cars for painting, is claimed to meet these conditions.

The Deoxidine Process

Briefly described, the deoxidine process consists in washing or rubbing over the steel surface with deoxidine, a liquid consisting of a mixture of alcohol, phosphoric acid, and water; and then washing off the deoxidine with water, after which the surface is dried and ready to paint. The practical application of the process as used at the Hudson Motor Car Co.'s plant will be described in the following.

When the car bodies arrive in the plant of the company, they have been more or less exposed to atmospheric conditions during transit and while in storage, and are covered with a thin film of rust or, at least, there are indications of the beginning of an attack on the metal by the atmosphere. The car bodies, as they arrive in the department where the rustproofing takes place, are mounted on a truck so that they can be easily handled by one or two operators. This truck is then pushed into position for the rustproofing treatment in a space surrounded by a pan or draining table, so that the deoxidine may be caught and prevented from spilling onto the floor. When the body has been placed in position within the draining table, as shown in Fig. 1, it is painted over with deoxidine, much in the same way as varnish would be applied to the surface. The drippings caught by the draining table run off into pails or pans and are used for a second rubbing over of the surface to be treated. The men doing this work wear rubber gloves and rubber boots, as well as large rubber aprons, because the liquid contains phosphoric acid, and would therefore attack the skin, as well as leather aprons and boots.

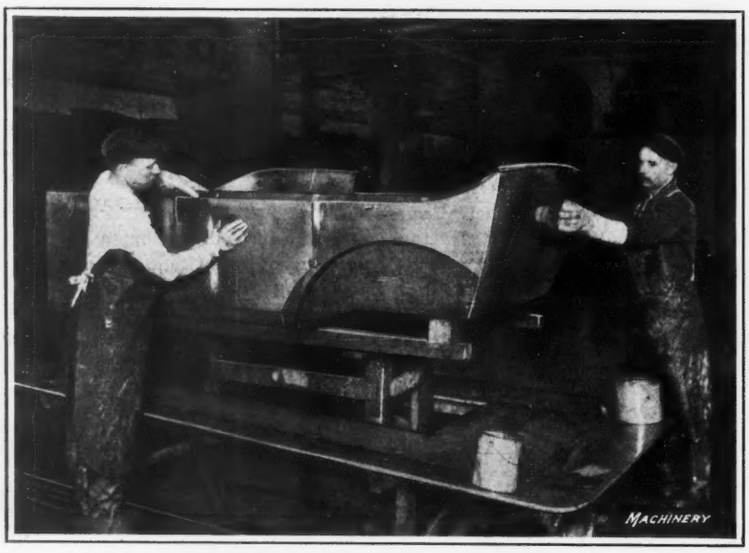


Fig. 1. Car Body in Position in Draining Table, Ready for Rustproofing

The second rubbing over of the surface of the steel plates is done with steel wool soaked in deoxidine. This rapidly removes the rust that has formed on the surface, and the steel wool also enters into the crevices, cleaning the whole surface thoroughly. Sometimes emery cloth is used, but, on the whole, steel wool is recommended. The phosphoric acid in the deoxidine removes the rust, the alcohol being used merely as a carrier of the acid.

Washing Off and Drying the Car Body

As soon as the car body has been thoroughly cleaned by means of the deoxidine, the truck upon which it is mounted is pulled away from the draining table and the body is moved to another part of the floor, where hot water is played upon it with a hose, the object being to wash off all alcohol, as well as all surplus deoxidine. (See Fig. 2.) The reason for using hot water instead of cold is to assist in the drying of the body, it being unnecessary to put the object in a drying oven. An air hose is finally blown onto the body for the purpose of drying out any cracks or seams, after which it is wiped off with a rag. It is now ready for the priming coat of paint. The treatment it has received has been found to prevent all rusting under the paint. In case it should not be convenient to start the painting immediately, the treatment will also prevent rusting for a considerable period. The experience of the Hudson Motor Car Co. points to the fact that bodies may stand for several months exposed to the atmosphere indoors before painting, without rusting.

It will be noted from the foregoing that the general process of applying deoxidine for rustproofing consists simply of washing over with deoxidine, washing off the deoxidine with water, and drying and painting.

Different Methods of Applying Deoxidine

The deoxidine may be applied in various ways. It is not necessary to apply it as described, if the articles handled can be more satisfactorily manipulated in other ways. Instead of varnishing over and rubbing the surface, the liquid may be applied by dipping or spraying. Small work, for example, is generally dipped and removed to a draining table, while large work is handled in the same way as the motor car bodies. Wooden tanks or buckets should be used for holding the liquid, and care should be taken not to heat it.

In washing off the deoxidine with water, small work may be washed off by dipping in a tank of water, a small stream of fresh water being constantly permitted to run into the tank, while an overflow pipe removes the surplus water. Gasoline should not be used for washing. Under ordinary circumstances, from five to ten minutes is allowed before the deoxidine is washed off. If there is a heavy scale of rust on the surface, the treatment described above—merely rubbing the surface with steel wool—will not be sufficient, but, in that case, scratch-brushing or the application of emery cloth or sandpaper before the deoxidine treatment would be used to remove the loose rust. Badly rusted work is often treated by rubbing with emery cloth while the work is kept wet by the use of deoxidine.

After the car body has dried, it may appear to be smeared with a white or yellow powdery deposit. This powder, however, need not be wiped off, as it has no effect upon the surface or upon the paint. In fact, this powdery deposit is a neutral salt which prevents the starting of any rust.

Fig. 2. Washing Car Body to remove Alcohol and Surplus Deoxidine

Other Uses of Deoxidine

In addition to the application of deoxidine for cleaning work for painting, as applied to motor car bodies and similar parts, the liquid may be used for cleaning surfaces that are not to be painted. In that case, if the work is covered with a heavy coating of rust, it is first sand-blasted, and then brushed over with deoxidine and wiped dry with a cloth before the deoxidine has had a chance to dry. In this case, the surface is not washed with water.

For work that is only slightly attacked by the atmosphere, the process is as follows: The surface is first rubbed with the liquid and emery cloth, and then washed off in water, after which it is again brushed over with deoxidine and immediately wiped dry with a cloth, no water being used after the second brushing over with deoxidine.

Automobile bodies may also be prevented from rusting in transit, when manufactured in one place and shipped to another factory, by the application of one coat of deoxidine to the work just prior to shipping, this coat being permitted to dry on the surface without washing or wiping. After the body has arrived in the factory where it is to be finished, the steel surface is again treated for painting in the same way as described for the car bodies handled at the Hudson Motor Car Co.'s plant. The preliminary coating of deoxidine applied before shipping keeps the surface of the steel comparatively clean, and leaves but a slight coating produced by atmospheric conditions to be removed in the final rustproofing process, which, therefore, can be carried out easily and rapidly.

E. O.

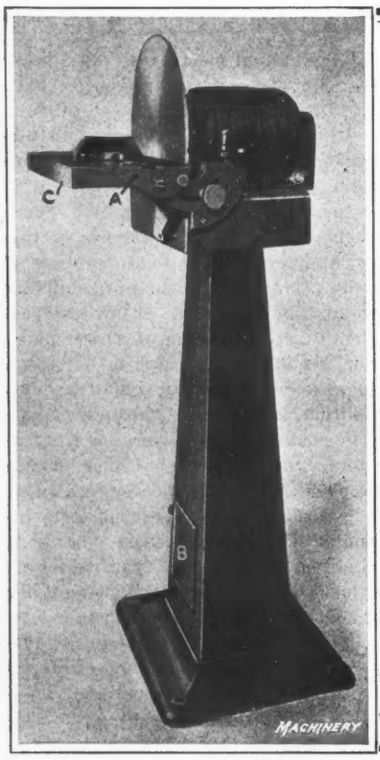
THE FIXED RADIAL CYLINDER ENGINE

In a paper presented at the annual meeting of the Society of Automotive Engineers, John W. Smith, a designer of fixed radial airplane engines, Philadelphia, Pa., states—in comparing airplane engines—that it is his belief that the air-cooled fixed radial cylinder engine offers a much more promising field for airplane development than either the V-type water-cooled, or the revolving air-cooled engines. There is a great deal of confusion in comparing weights of airplane engines, it being customary to refer to the weight of the water-cooled engines by giving the weight dry, omitting the weight of the water and the radiator. A fair comparison of engine weights should include the entire power plant mounted in the fuselage with sufficient fuel and oil for some hours of operation. The water-cooled engine requires more fuselage space and in addition an elaborate sheet-metal casing and exhaust piping to complete the power plant. The mounting of a nine- or ten-cylinder radial air-cooled engine shows a saving in weight over the water-cooled engine, when all elements are included. If the entire power plant is included in giving the weight of the water-cooled engine, it will be found that the lightest water-cooled type, which is probably the Liberty engine, will weigh over 2.7 pounds per horsepower for the 400 horsepower size when installed in the airplane. A 400-horsepower, ten-cylinder, fixed radial engine, having a 5½-inch bore and a 6½-inch stroke, has an estimated weight of 1.3 pound per brake horsepower, and a nine-cylinder engine of the same type, having a 5½-inch bore and a 6½-inch stroke, is said to develop 310 horsepower and to weigh 640 pounds, or 2.06 pounds per brake horsepower, which shows that the fixed radial type engine has a weight advantage of fully 0.6 pound per horsepower over the water-cooled type.

The construction of the fixed radial engine makes for reliability, because of simplicity and compact design. The English have developed the roller bearing to a point where it is practically infallible for crankshaft and connecting-rod applications. A simple oiling system which does not depend upon a fixed pressure, and in which the oil is sprayed from one point only, is adaptable to and practical in an all-roller bearing, fixed radial engine. The circulating and fresh supply of oil is pumped through a hollow crankshaft and is thrown off by centrifugal force onto all the cylinders in a uniform manner, the bottom cylinder getting the same supply as those at the top.

To produce a perfectly balanced fixed radial engine, the axes of all cylinders should be in the same plane, and the pistons connected to opposed two-throw cranks. An engine equipped with a single-throw crank must be counterbalanced by weights, and for this reason it is evident that considerable weight can be saved by resorting to the double-throw crank construction.

There is every reason to believe that the fuel consumption of the fixed radial engine should be at least as good as that of the conventional V-engine, since the mean effective pressure at high speeds can, with proper design, be made to equal that in the best water-cooled practice, while the bearing friction is less with roller-type bearings than with plain bearings.



Building a Sanding Machine

Article Dealing with the Methods of Machining the Important Parts of a Sanding Machine, Describing the Jigs and Fixtures Used, and General Procedure in Building the Machine

BY ROBERT MAWSON

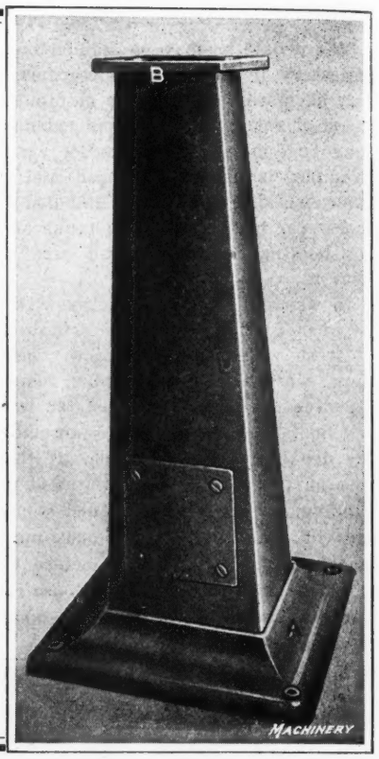


Fig. 1. Motor-driven Sanding Machine

Fig. 2. Improved Type of Column

THE sanding machine shown in Fig. 1 (developed by the Electric Specialty Co. of Stamford, Conn.) was designed to supersede the hand methods which are commonly used in the pattern shop for planing, beveling, squaring, and drafting patterns. This machine can also be used to take the place of a milling machine on light work, as well as for grinding metal of various degrees of hardness according to the grade of abrasive used on the disk. The machine is commercially known as a speed sander, and, as will be seen from the illustration, this particular machine is motor-driven and mounted on a column. A somewhat unique design of column which is made with the top and base of cast iron united by a sheet iron shell is shown in Fig. 2, and is giving excellent results, being stronger and much lighter than the one-piece cast-iron type. The improved type of column shown in Fig. 2 also has an advantage over the cast-iron design from a manufacturing standpoint.

The base casting *A* and the top *B* are made of cast iron as previously stated, and the column proper of No. 18 gage sheet steel. This shell, after being cut and bent to shape, is welded together, and strips of steel, approximately 1½ inch wide and ¼ inch thick, of suitable length are fitted at the top and bottom of the column shell. These strips are either riveted or, preferably, spot-welded to the shell. The ends of the strips are protruded through the cored holes in the top and base castings, respectively, and bent over or clinched, thus producing a very rigid construction. These steel pieces may be seen in the top part of Fig. 2. The weight of the cast-iron column is 120 pounds, whereas the total weight of the column of the three-piece type is but 35 pounds. It was thought at first that the three-piece column would tend to rattle and cause excessive noise, as might be expected of sheet metal parts, especially as the disk of the machine travels at a high rate of speed. However, this is not the case, and machines manufactured with this type of column have proved to be as rigid and as silent in operation as machines having the heavy cast-iron column.

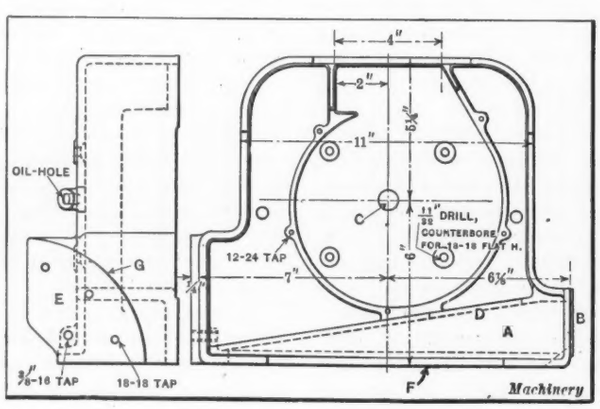


Fig. 3. Sanding Machine Base

An interesting feature of the machine is the method employed to remove the wood dust or metal grindings. A detail of the base of the machine proper is illustrated in Fig. 3. The disk revolves inside the cored pocket *A*, the outer face of which is covered with a flange, as shown in the illustration of the assembled machine, Fig. 1. If a blower system is available in the shop, a pipe is connected to the flange *B*, Fig. 3, through which the dust is drawn away as it is produced. If it is desired to have the machine self-contained, however, as shown by Fig. 1, a fan is provided, the shaft of which is mounted in a bearing in the hole *C*, Fig. 3. The fan is driven by a round belt which can be seen at the rear of the motor in Fig. 1. The correct speed may be obtained either directly from the motor shaft as in the present case, or if it is necessary to reduce the revolutions per minute of the motor, by suitable gearing. On the machines that are equipped with a fan, the flange *B*, Fig. 3, is covered with a plate, and the dust is drawn through the opening *D* by means of the fan and is forced through the passage *C* of the blower cap, Fig. 4. A pipe is attached to the end *B* of this passage, the lower end of which fits into a receptacle placed at the bottom of the column inside the machine. When it is desired to remove the dust, the receptacle may be conveniently taken out through the door *B*, Fig. 1. On the type of machine which is not supported by a column and which is usually placed on a stand or bench an opening is cut in the table of the bench for the passage of the pipe which is

fitted to flange *B*, Fig. 4, just as it is with the column-supported machine. This pipe deposits the waste material into a box under the bench, from which it can be conveniently removed.

Referring to Fig. 1, it will be noticed that a quadrant and graduated segment are fitted to the side of the machine. With the aid of the index scribed on the quadrant, the plane of table *C* may be adjusted to give a range of 60 degrees, that is, from 45 degrees below to 15 degrees above the horizontal plane. A micrometer head attached to the segment, as shown in the illustration, can be used to obtain very accurate adjustments, which, of course, is convenient when performing such operations as duplicating angular beveled surfaces. A V-block equipped with a tongue to fit the slot of the machine table, and which is capable of swiveling on the tongue, will be found convenient for machining angular surfaces in the horizontal plane.

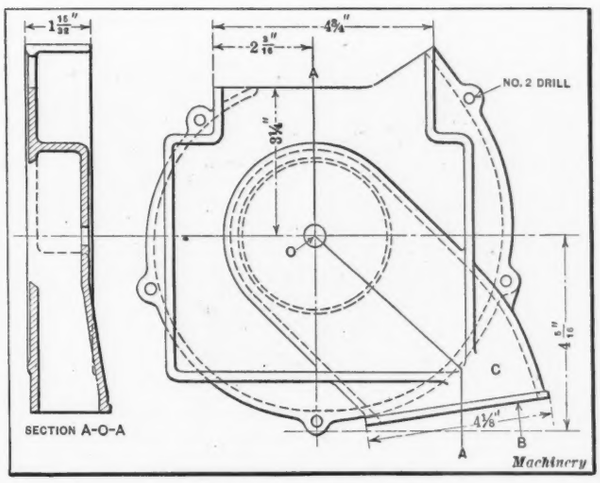


Fig. 4. Blower Cap Details

Machining the Base

The first operation when machining the base consists of grinding the front face *F*, Fig. 3, to obtain a dustproof joint when fitting the flange which forms the outside wall of the cored pocket *A*. The second operation is the milling of surface *E*, which furnishes the seat for the quadrant. The third operation is a drilling operation, and is performed in the jig shown in Fig. 5. The jig is positioned by two pins *A*, which fit into the locating holes in the end of the long cored chamber in which the disk revolves. Stop-plates are shown in the illustration resting on the upper surface of the casting. Five 11/32-, and two 13/32- inch holes are then drilled in the upper side of the casting, the center hole *B* for the fan-shaft bearing being redrilled later as a separate operation. The four No. 14 drill holes on the end of the casting are then drilled, these holes being used for the dust exhaust pipe system. The fourth operation is machining the four holes for assembling the quadrant, and the jig used is shown in Fig. 6. The jig is located by the plate *A* which fits against the ground face *F*, Fig. 3. The adjusting screw *B*, Fig. 6, when tightened, draws the stop *C* against the curved contour of the flange *G*, Fig. 3, thus securely clamping the jig in place. Three ¼ inch diameter and one 5/16 inch diameter holes are drilled, after which these holes are tapped as shown by the notations on Fig. 3. The fifth operation, referred to above, is that of redrilling the fan-shaft bearing hole to ¾ inch diameter and counterboring it. The oil-hole for the fan-shaft (see Fig. 3) is afterward drilled.

Machining the Table

When machining the table, the first operation is gang-milling the top and slot, the cutters being set up in the usual manner. The manner in which the castings were formerly held for this operation was by means of finger straps which fitted into drilled holes *A*, Fig. 1, in each end of the table, the lower edge of the table resting on two parallels. It will be apparent that these holes, as formerly used for holding the table for this operation, were somewhat of a disfigurement. Of course this fault might have been overcome by plugging the holes, but as this would have entailed another operation, and as it was necessary to provide adequate means for holding the casting during the milling operation, the pattern was changed and lugs cast on as shown in Fig. 7. These lugs are designed simply for the purpose of holding the casting while milling, and of course are removed in the subsequent operation of milling the ends, so that when finished the casting presents a much better appearance than did the earlier design. The second operation consists of milling the edge surfaces. Two castings are clamped against the vertical faces of an angular plate, which is fastened to the table of the milling machine. The finished faces of the castings, as milled in the previous operation, are squared up with the vertical surface of the angle-plate fixture which, of course, is squared with the face of the table. First, the two ends are machined with a side cutter, setting over the milling machine table when milling the opposite end to obtain the correct length of the finished piece. The castings are then turned 90 degrees and the long straight edges of both castings are machined at once, using a face cutter. The third operation consists of milling the long beveled edge which comes next to the disk. One casting is machined at a time, and is located on the vertical surface of an angle fixture by a tongue that fits into the longitudinal slot in the table top, and is then secured by suitable means, such as parallel clamps. In this way, when the milling machine is once set, all the tables are milled the same distance between the slot and this long beveled edge, that is, from the slot to the disk when the machine is assembled. A standard angular cutter is used in this operation. The fourth operation consists of milling a slot for the segment on the under surface of the table, and its location may be determined by referring to the assembled machine.

The fifth operation is that of drilling the holes in the edge of the table, which are used in assembling the segment, and the jig used in this operation is shown in Fig. 8. The jig

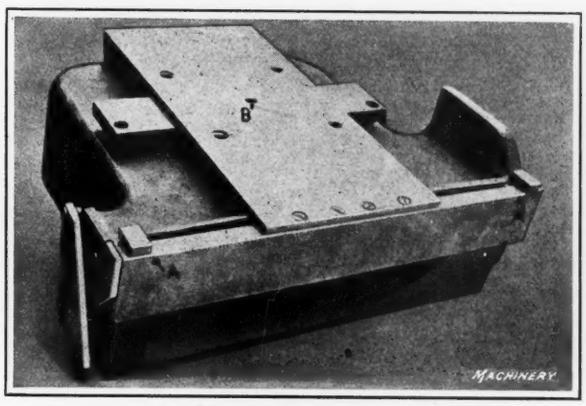


Fig. 5. Jig for drilling Holes in the Base

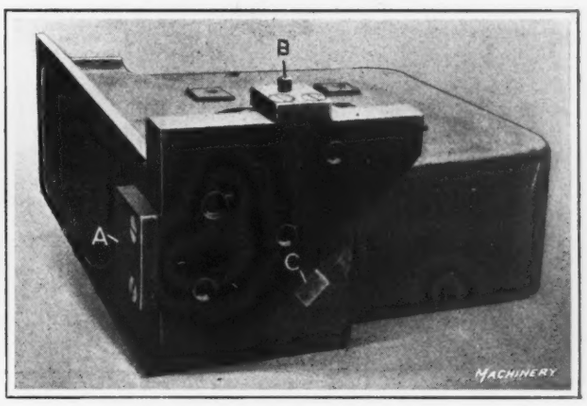


Fig. 6. Jig for drilling Quadrant Holes in Base

is located parallel to the end of the table by means of the piece *B*, the lower part of which fits into the slot that was milled in the previous operation. The jig is then pushed against the beveled edge *D* of the table, and the knurled-head screw *C* secures it in position. One 5/16- and one 31/64-inch hole are then drilled in the vertical arm *A*.

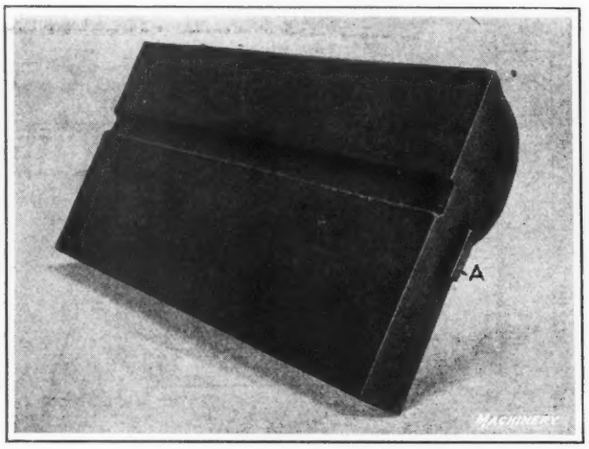


Fig. 7. The Improved Type of Table

Machining Operations for the Quadrant and the Segment

In Fig. 9 are shown a finished quadrant ring, at the left, and a finished segment ring, at the right. The machining operations pertaining to the quadrant will be considered first. In performing the first operation, the center hole is bored to size, the casting being held in a three-jawed chuck which engages the large diameter. The outside surface is faced and the outside bevel formed as a part of the first operation and before removing from the chuck. The beveling of the outside surface is not very important, as this is done only for appearance. For the second operation, the quadrant ring is reversed and is centered by placing on the short plug of a fixture fitting into the bored hole. This fixture is arranged with three straps which are tightened on the ring, holding it securely. The center hole is then counterbored, and the inside bevel *E* is formed by setting over the toolpost to the required angle. For performing the third operation, the casting is again reversed and located on an expanding plug which fits the bevel formed in the previous operation. The casting is then faced until the ring is of the required thickness.

The fourth operation consists of cutting the ring into four parts to make the quadrant. The casting is mounted on a ring, *A*, Fig. 10, which is a counterpart of a complete segment ring with its outside diameter fitting into the large bored hole of the quadrant ring. Two screws *B* hold the ring securely in place, the milling cutter being fed through the ring at *C*, and being located by a steel guide pad attached to the fixture, as shown in Fig. 13 at *B*. The nuts at *B*, Fig. 10, are then loosened and the ring is revolved until the first slot is at *E*—a revolution of 90 degrees—and it is located at this point by a steel gage-block which engages the slot in the ring and the slot *E* in the locating ring. The next slot is milled at *D*, the milling cutter being positioned as before by means of the gage-block, using the slot just made at *C* after the ring has been revolved 90 degrees, as before. This procedure is continued until the four cuts have been made. The fifth operation consists of drilling the holes in the quadrant, and the jig used is shown in Fig. 11. The casting is placed on the machined surface of the jig, which fits inside the turned recess of the quadrant, and is pushed against the stop *A* and held against it with a strap (not shown in the illustration) on the under side of the jig. Four 5/16-inch holes are then drilled, also two No. 13 drill holes and one No. 19 drill hole, one of the 5/16-inch holes being on the plate *B*.

When machining the segment which, as shown to the

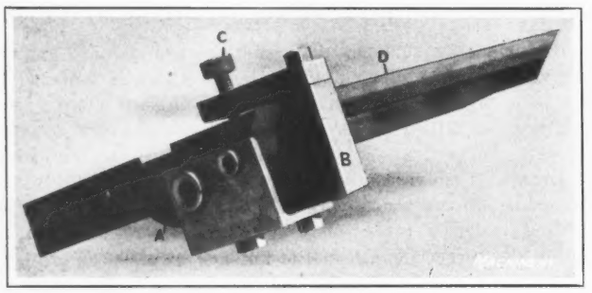


Fig. 8. Jig for drilling Holes in Edge of Table

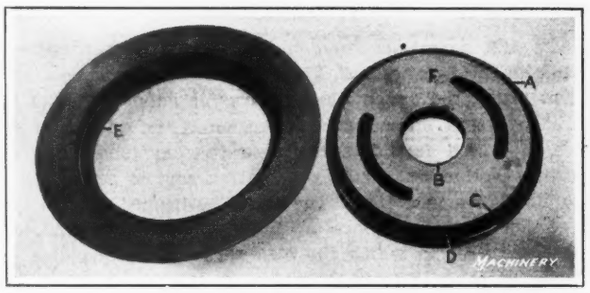


Fig. 9. The Machined Quadrant and Segment Rings

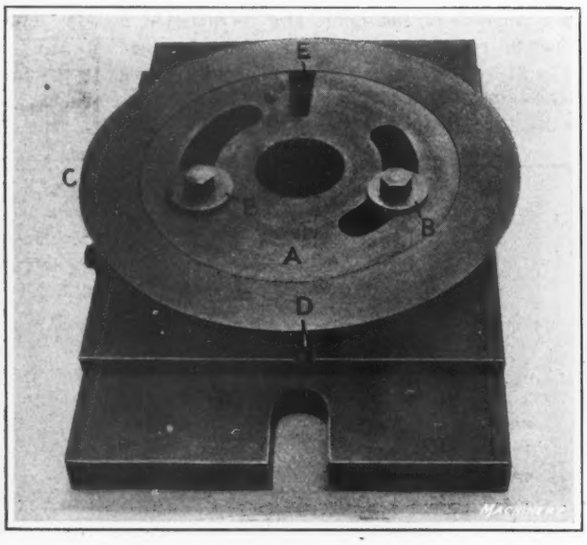


Fig. 10. Milling Fixture used for quartering Quadrant Ring

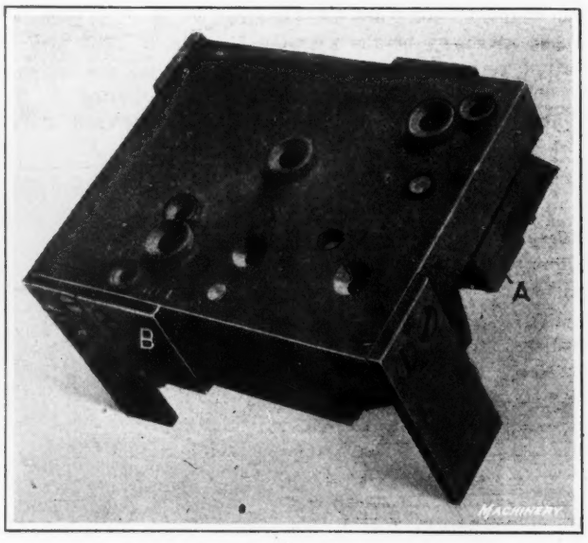


Fig. 11. Jig for drilling Seven Holes in the Quadrant

right in Fig. 9, is also made from a ring casting, the piece is first chucked by the cored hole *B*, the smaller diameter being next to the face of the chuck. For the second operation, the large diameter *A* is turned and the outer surface faced. The casting is then reversed in the chuck and located by a recess, which conforms to the large turned diameter and is held by means of two screws similar to the method of holding illustrated in Fig. 10. The small diameter *C*, Fig. 9, is then turned, the beveled surface *D* formed, and the hole *B* bored in the third operation. The fourth operation consists of facing the surface *F* to the correct thickness. During this operation the casting is again reversed and located by a plug that fits into the bored hole *B*, and is held by beveled ring segments which fit into the surface *D*, machined in the previous operation. For the fifth operation the casting is placed on a milling fixture and bisected, in the same way that the quartering operation is performed on the quadrant, the correct location for the milling cutter being determined by set blocks. The sixth operation is the rounding of one end of the segment by milling, so that it will clear the under side of the table while being assembled. This is best shown by Fig. 15. The drilling jig used for the seventh operation on the segment is shown in Fig. 14. The casting is slid into the jig and rests against the stop-plate *A*, being held in position by means of the screw *B*. The correct location is obtained in a similar manner to that described for the quadrant, a turned bevel surface *C*, on the jig fitting into the beveled recess on the segment. Four holes are then drilled: one 31/64 inch in diameter, one No. 12, one No. 19, and one ¼ inch in diameter. One of the finished drilled segments is shown beside the jig in the illustration. The 31/64-inch hole *D* is reamed to ½ inch diameter before removing the piece from the jig, and the hole at *E* is afterward tapped.

Details of the quadrant and segment are shown in Fig. 15, and the operations described on these parts can be more readily followed by reference to this illustration. Fig. 15 also gives the sizes of the taps and pins used in the various holes. Another important feature shown in this illustration is the method of gaging the dimensions of the inside beveled surfaces by means of ¼-inch steel balls. With this method it is an easy matter to gage the distance back from the finished face by the use of an ordinary micrometer, the size of the balls being known. This method is similar to the well-known one used for measuring dovetail ways employing the use of finished steel plugs. The various bored holes are tested by the use of "Go" and "Not Go" gages. The outside diameters are measured with micrometers. Gages are also used to obtain the correct measurement of the 60-degree angle, and after the cross-slide has once been correctly set, the machining of this bevel is simply a matter of removing stock until the dimensions given are obtained. The eighth and final operation on the segment consists of making the graduations. This is done in a punch press, the casting being located in the die by a pin which fits into the ½-inch reamed hole (see Fig. 15), and the horizontal surface at the other end coming against a stop-plate. The punch with the graduated lines and figures is then forced down onto the casting, and the graduated lines and figures are stamped thereon.

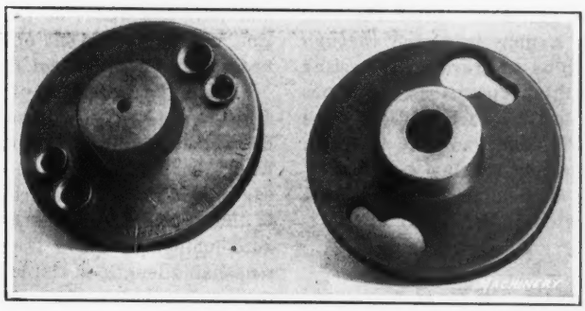


Fig. 12. Disk Hub and Jig for drilling it

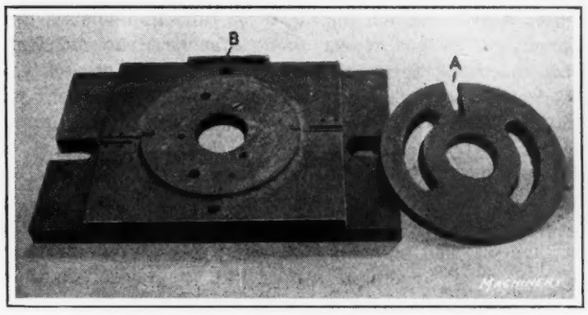


Fig. 13. Milling Fixture illustrated in Fig. 10, showing Guide Pad for Milling Cutter

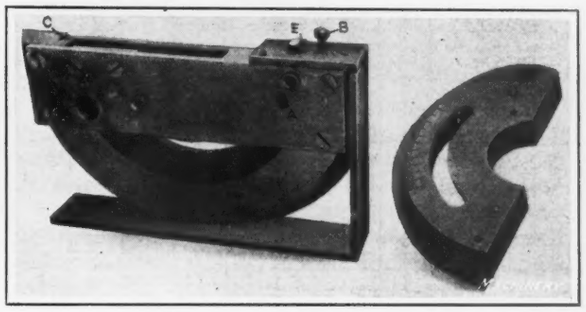


Fig. 14. Jig used for drilling Four Holes in Segment, and Finished Segment after Drilling Operation

The Disk Hub

One other interesting feature of the sanding machine is the arrangement by which dull disks can be readily removed and replaced. This change can be made in a very short time because of the simple yet effective design of the disk hub. This detail and the jig for drilling the holes in it are illustrated in Fig. 12. The method of removing the disk is to loosen the two nuts which hold it to the hub, and give the disk a slight turn, which will bring the nuts opposite the large hole, through which they are withdrawn as the disk is removed. The only machine work on this piece consists of drilling two pairs of holes and slotting through each pair. The piece is located in the jig by a pin which

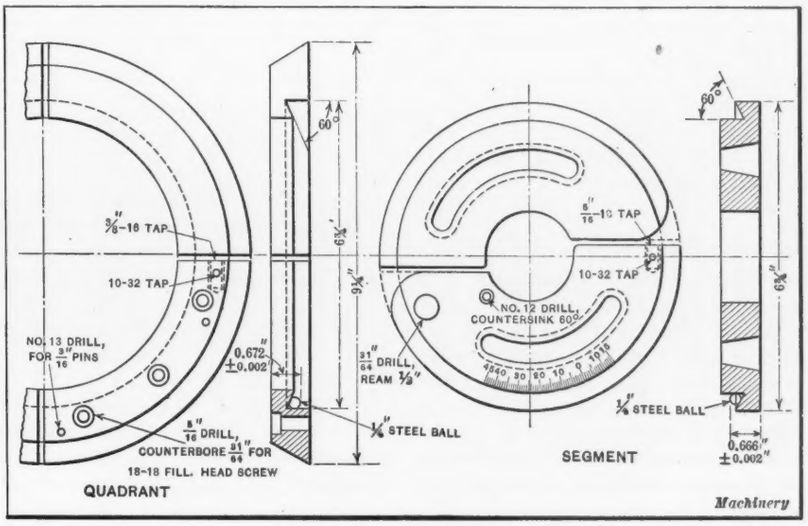


Fig. 15. Details of the Segment and the Quadrant

fits into the hole in the hub of the disk. After the first 5/16-inch hole has been drilled, a plug is placed through the bushing and into this hole, so as to prevent the casting from revolving during the remaining operations. Another 5/16-inch and two 13/32-inch holes are then drilled. The 13/32-inch holes are redrilled to ¾ inch diameter, and each pair of holes is connected, as shown, by slotting with a 5/16-inch end-mill, while the casting is held and rotated in a chuck on a regular milling machine index head.

* * *

PITCH OF BROACH TEETH

In the manufacture of broaches, there are many questions which require serious consideration if the success of the finished tools is to be insured, and, owing to the fact that each type of work has to be investigated on its own merits, it is difficult to give any definite rules that will govern the design and manufacture of these tools. Formulas for determining broach dimensions cannot be followed very closely, but must be taken as a guide in conjunction with the lessons taught by experience. The material of which the parts requiring to be broached are made, as well as the shape or design of the part and the amount of material to be removed all have their influence on the proportions of the broaches. The amount of metal which each tooth of the broach is called upon to remove also influences the volume of chip space required, and this, in turn, governs to some extent the distance between the broach teeth, or the pitch, as well as the depth of the chip space.

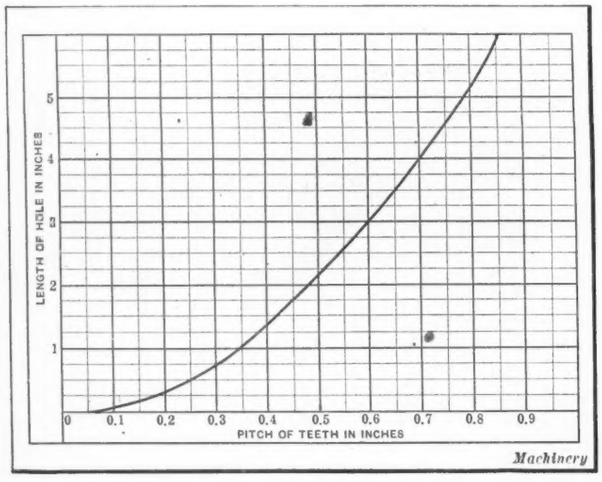


Chart showing Pitch of Broach Teeth

Some experienced manufacturers, after extensive experiments and costly failures, have come to the conclusion that the pitch of the broach teeth is one of the most vital points, as when this dimension is correctly determined, the other proportions and details can be arranged to suit. The pitch should not be made too fine, but as large as convenient under the circumstances, without causing weakness in the core of the broach. It has often been thought that a broach with finely pitched teeth, each tooth removing a comparatively small amount of metal, stood a better chance, but this is not by any means the case.

Special Rules for Pitch of Broach Teeth

In attempting to broach a hole of any given length, it is obviously a good point to have at least two teeth in an actual cutting position at all times, until the broach has finished cutting, but with certain work, the length through the broached portion is the matter which must be first considered. In some instances, as, for example, a thin disk, it is not possible to arrange for more than one tooth to be passing through the broached portion at all times, and then it is highly advisable to arrange the parts in a row so that the whole depth of the hole to be broached is three times the pitch of the broach teeth. Care should be exercised in clamping the disks, so that they are all kept absolutely in line, as one falling out of place would cause fracture of the broach or destruction of the part.

Should the article be of a peculiar design which will not allow several to be broached at a time, then the broach must be supported and kept in its correct position by a guide hole which bears on a part of the broach that has no cutting edges, and which, in turn, is definitely located in relation to the article being broached. Work in connection with the automobile and allied industries, however, has generally a reasonable length of the broached portion, and in such cases the accompanying chart will be found to give good results in determining the pitch of the teeth. In order to avoid the manufacture of unnecessary tools, one size of broach is frequently used for several different parts having varying lengths of hole, and in such cases the distance through the shortest hole should be used in determining the pitch of the broach teeth.

The results given in the chart enable a reasonable pitch to be determined, and very fine pitches are avoided as much as possible, as the power required to pull a fine-pitched broach through the work frequently causes the end of the broach to be pulled off, owing to the cutting portion becoming choked in the hole.

Differential Pitching of Teeth

The advantages of spacing the teeth irregularly (to a limited degree) do not appear to be fully appreciated, or if appreciated, do not appear to be considered as sufficiently great to justify the slight additional trouble necessary in differential spacing. There is no doubt, however, that particularly when broaching comparatively hard or tough material the additional time occupied in the manufacture of the broach is fully compensated for. The object of this modification in design is to produce a better finish on the work; at the same time the working life of the broach is somewhat lengthened. The broaching operation can by no means be regarded as a smooth operation, like the taking of a fine cut on a lathe, but there is always a certain amount of chatter, and in the case of a broach having teeth evenly spaced along its whole length, any one tooth has a tendency to produce the same irregularities as the preceding tooth, and consequently the trouble is to some degree accentuated. When teeth of slightly varying pitch are used, any given tooth tends to remove irregularities left by the previous tooth.

There is no fixed rule for determining the most suitable amount of variation from standard, but probably an increase of 0.004 inch for each of four spaces, making a total of 0.016 inch for the last tooth, will be found generally satisfactory; the next following space will be made standard, and then the increase started again.

In the case of a broach for which a tooth pitch of ⅝ inch has been decided upon, the spacing would be as follows:

	Inch		Inch
First space	0.625	Fifth space	0.641
Second space	0.629	Sixth space	0.625
Third space	0.633	Seventh space	0.629
Fourth space	0.637	Eighth space	0.633

and the sequence repeated.

In some instances more than and sometimes less than the increment suggested above is used; spline broaches, for automobile sliding gear holes, are mostly made with equally spaced teeth, but experience has proved the value of the idea, particularly in the case of tools where it is necessary to remove metal around the greater portion of the cross-section of the broach.

E. N.

* * *

It is mentioned in the *Scientific American* that the General Electric Co. has conducted experiments on ingot iron with a view to determining how soft this iron may be made by proper treatment. It is stated that if ingot iron is surrounded by hydrogen for three hours at 1600 degrees F., and slowly cooled, it will become about as soft as soft copper.

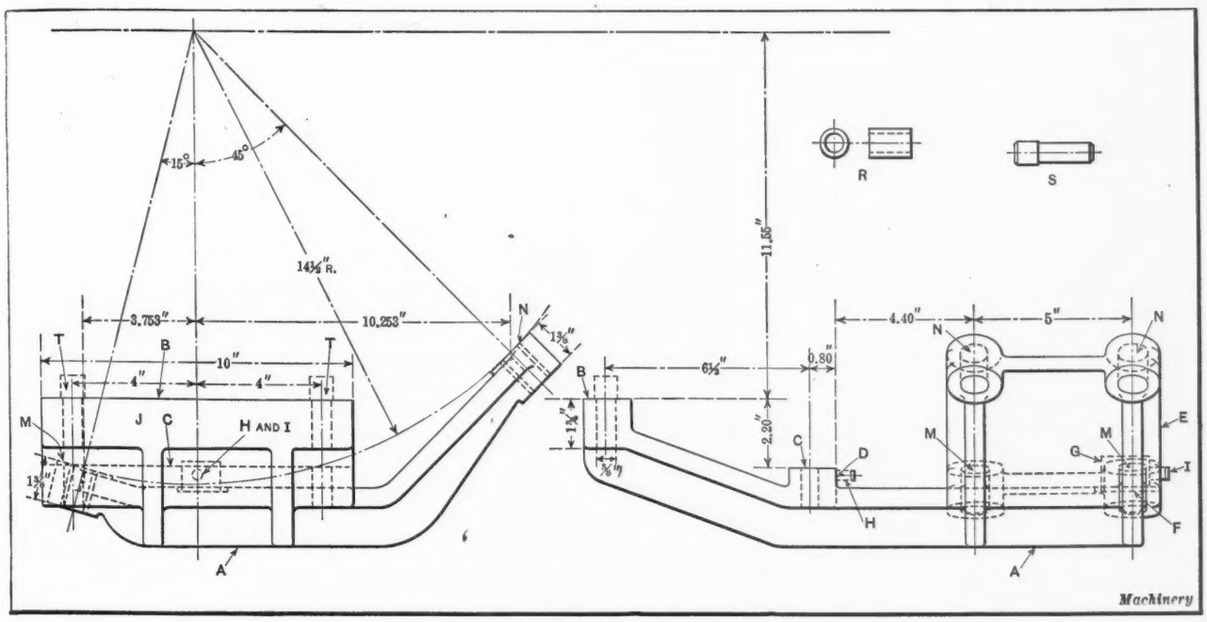


Fig. 1. Details of Drill Jig for Gun Carriage

MAKING A DRILL JIG FOR ACCURATE WORK

METHODS EMPLOYED IN LAYING OUT AND MACHINING A DRILL JIG AT THE PLANT OF THE PEERLESS TOOL & MACHINE CO.

THE following article describes the methods employed in laying out and machining a drill jig for an airplane gun carriage, at the Peerless Tool & Machine Co.'s plant, Brooklyn, N. Y. The details of the jig are shown in Fig. 1, and from this illustration it will be evident that the machining of the work within the required limits of accuracy presents problems of unusual interest, especially as the work was done on an ordinary type of plain milling machine. The methods of using locating buttons, sine bar, and height gage in setting up the work should be of especial interest to toolmakers, as they involve some unusual applications of these devices.

Machining Operations

The first machining operation was the milling of the base of the jig *A*, Fig. 1. This was done merely to provide a locating surface for the succeeding operations. After the base *A* was machined and accurately scraped, it was placed on the table of the milling machine and the surfaces *B*, *C*, and *D* were milled. A finish cut was then taken over the end of the casting at *E* for the purpose of providing a finished surface for locating and measuring the work. These four surfaces were all milled without changing the position of the piece on the milling machine table, thus insuring the accuracy of the work. The next step was the milling of a surface about 2 inches square at *F* for the purpose of affixing a block *G* to which a locating button could be attached. The milling of surface *F* was accomplished in a vertical milling machine employing an end-mill. After the block *G* with the button *I* attached, was screwed to the casting, the button *H* was attached to surface *D*. The position of buttons *H* and *I* was determined by gaging from surface *A* to the top of the buttons to obtain their correct vertical location in relation to the surfaces *B* and *C*. Their longitudinal position was determined by locating the buttons midway between the ends of the piece *J*. Buttons *H* and *I* are 0.400 inch in diameter. These buttons may also be seen in Fig. 2 at *H* and *I*.

Fig. 2. Checking Accuracy of Work

After the buttons were attached, the work was bolted to the milling machine table in the correct position for milling the surface *M*, Fig. 1. A sine bar and height gage were used to obtain the correct angle of 15 degrees, using *C* as a locating surface for the sine bar block. After the piece was properly set in the angular position, the depth of the cut to be taken to produce the required accuracy was determined in the following manner: By referring to Fig. 3 it will be seen that the locating button *H* was attached at a distance of 14 inches from the center *O* instead of at the point *E*. This was found necessary, because the casting interfered with the location of the button in position *E*. As has been previously stated, the casting was located and fastened on the milling machine table in such a position as to allow accurate machining of the surface *C*. By a similar process it is possible to locate the casting so that the surface at *I* can be accurately machined to a 45-degree angle with line *OH*.

Calculations of Dimensions

After providing a means of locating the work to produce the correct angles of 15 and 45 degrees, the remaining problem was to devise methods of machining the surfaces at *C* and *I*, Fig. 3, to the correct depth and to provide means of accurately locating the holes shown at these points. *H* represents the center of the locating button. Line *AH* is perpendicular to line *OC*. Therefore:

$AH = OH \times \sin AOH = 14 \times 0.25882 = 3.6235$ inches

Thus it will be seen that the center line of the hole should be located at a distance of 3.6235 inches from the center of the button *H*.

Now

$$OA = OH \times \cos AOH = 14 \times 0.96592 = 13.523 \text{ inches}$$

$$AC = OC - OA = 14.5 - 13.523 = 0.977 \text{ inch}$$

The height K represents the distance from the finished surface at C to the top of the button H, and it is evident that this distance can be easily gaged.

$$K = AC + \tfrac{1}{2} \text{ (diameter of button } H) = 0.977 + \frac{0.400}{2} = 1.177 \text{ inch}$$

In order to facilitate the gaging of the height K, a test-block was made 1.177 inch long and used during the milling operation, about 0.002 inch being allowed for scraping and lapping the surface C. In machining the surface at I the

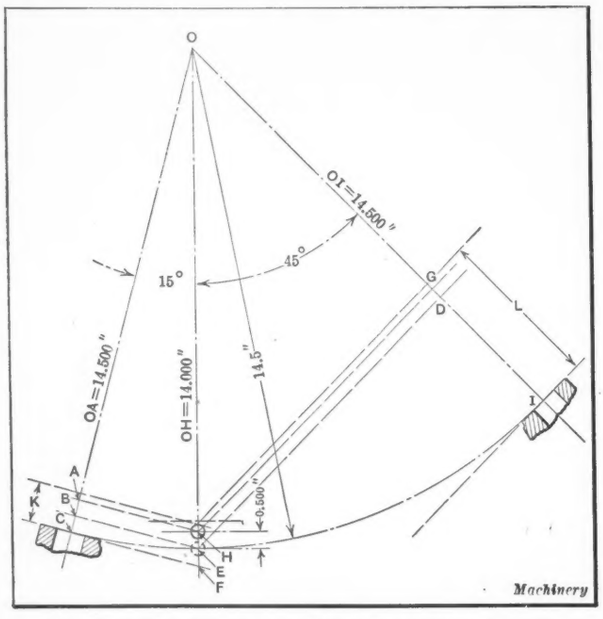


Fig. 3. Problem involved in locating and measuring Angles and Positions of Finished Surfaces

same methods were employed as in the case of surface C. After the holes at M and N, Fig. 1, were bored and finished, the jig was set up on a testing block as shown in Fig. 2, and the accuracy of the work was carefully checked. Drill bushings R, Fig. 1, were then made and fitted into the holes M and N, and hardened plugs S were fitted into the holes T, which completed the jig.

MACHINERY is indebted to L. Naham, owner and superintendent of the Peerless Tool & Machine Co., for his assistance in obtaining the information required in the preparation of this article, and also to Morton Wood, the toolmaker in charge of the work described.

* * *

AIRPLANE DEVELOPMENT

The following statement of the National Advisory Committee for Aeronautics shows the development in airplanes which has been made since 1903. The first man-carrying airplane flights were made in December, 1903, with the Wright Bros. engine, developing 12 horsepower and weighing 152 pounds, or 12.7 pounds per horsepower. In 1910, the average horsepower for aeronautic engines had increased to 54, and the weight had decreased to 5.7 pounds per horsepower. After another seven years, in 1917, the average power output had advanced to 243 horsepower, and the weight had decreased to 2.8 pounds per horsepower. In March, 1918, the Liberty motor developed 432 horsepower for a weight of 808 pounds, or 1.86 pound per horsepower. At present, the Liberty motor is developing a maximum of 450 horsepower for a weight of 825 pounds, or 1.83 pound per horsepower. The average consumption of fuel decreased from about 0.8 pound per horsepower in 1903 to 0.55 pound in 1918, and for the Liberty engine to 0.50 pound. The present consumption is about 0.46 pound per horsepower.

MACHINE TOOL CATALOGUES

BY HARRY W. DAVIS

The writer believes that it is opportune at this time to emphasize a use for which machine tool catalogues are not ordinarily intended, but which would meet a long-felt need for those who are engaged in designing tools, jigs, or fixtures. There are certain dimensions of a particular machine tool to which the jig or fixture is to be applied that must be known before the design can be undertaken. These dimensions may be obtained in various ways, but it is usually a tedious job and often entails much waste of time.

In some drafting-rooms, the only method of obtaining these dimensions is to go into the shop and take the measurements directly from the machine itself. This practice is not to be recommended, as ordinarily the draftsman does not possess suitable measuring tools and must, therefore, either borrow from the tool-crib or from some mechanic in the shop. In large plants, the practice of lending tools from the tool-crib on check is generally strictly adhered to, and this would cause the tool designer to lose considerable time in obtaining the desired tools. It might, in fact, necessitate securing a written order from someone in authority before the required equipment is obtained. Another objection to the practice of a draftsman obtaining his data directly from the shop is that his presence there often interferes with production. Some drafting-rooms have a number of charts which show the needed dimensions of a number of machine tools in the shop, but these charts are not always complete, and as they are usually made during dull times as a "fill-in" job, they are not always kept up-to-date, so that when new tools are added to the shop equipment, the charts become incomplete.

There are a few machine tool catalogues which give some of the dimensions required by the tool designer, but the writer has never seen one that contained a sufficient number of these important dimensions. A milling machine catalogue may give the number of the taper of the hole in the spindle, and the working surface and travel of the table, but this is about all the information of use to the tool designer which is found even in the best milling machine catalogues. If it is desired to know the number of slots in the table, their width, the distances between their centers, the distances from the inside edge of the table to the column with the table in the extreme back position, the distances between the top of the table and the center of the spindle when the work is at its lowest position, the outside diameter of the spindle nose, and many other dimensions which need not be mentioned, it is necessary to resort to some such means as have just been referred to. Not only is such information lacking in the milling machine catalogue, but an examination of the catalogues of some of the best known manufacturers of lathes, planers, shapers, boring mills, drilling machines and grinders, will show that a great deal of essential information is omitted. The purpose of these comments is to suggest that these much needed dimensions be supplied. In some cases, it will require the addition of but a single page to the catalogue, and in most cases not more than two pages. On the additional pages should be shown two or more views of the machine, containing all dimensions of use in designing fixtures to fit a standard machine tool.

Some manufacturers may take exception to this suggestion on the ground that it is expensive to distribute catalogues indiscriminately to those who are not prospective buyers, and that if this information were included in their catalogue, every tool designer in the country would send for a catalogue. In such cases, in place of an expensive catalogue, a line cut of the machine could be furnished which would give all the information that the tool designer needs. If, then, all the leading machine tool manufacturers should cooperate and decide on a standard sized sheet which would fit a loose-leaf binder, it would be possible for every engineering office to possess a neatly bound book containing indispensable information that would always be up-to-date.

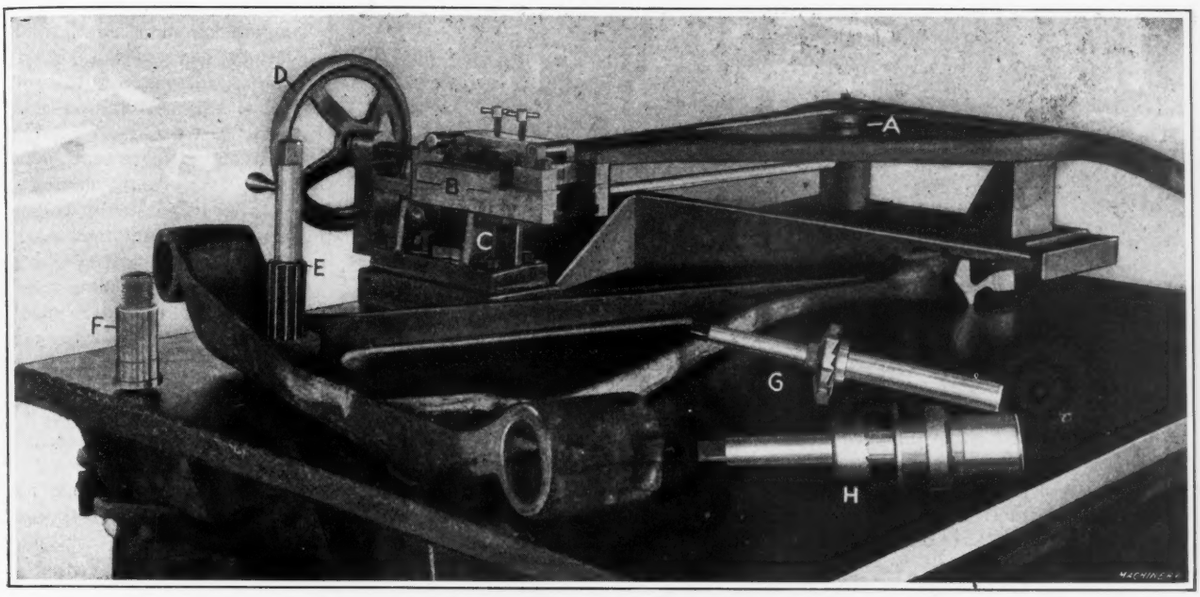


Fig. 30. Radial Broaching Fixture for machining Curved T-slot in Yoke

Making Naval Gun Mounts

Special Fixtures for Broaching, Milling, and Drilling Operations, and Testing Methods
Third and Concluding Article

BY FRANKLIN D. JONES

AS explained in the second article on this subject, published in the March number of MACHINERY, the principal parts of the type of sight mechanism used on 4-inch naval guns are the sight-bar and the yoke. The accuracy of the sight depends largely upon the accuracy of these two parts. This article, which is the third and concluding one, deals with certain machining operations on the yoke and with some of the special fixtures used in connection with this work at the plant of the Mead-Morrison Mfg. Co., East Boston, Mass.

Radial Type of Broaching Fixture

At the end of the yoke there is a curved T-slot for receiving a curved section of the sight-bar head which is machined by means of a radius planing fixture. This T-slot is broached to size by the radial type of broaching fixture shown in Fig. 30. The yoke swivels about its vertical rocker pin which engages a close-fitting hole at *A*. The opposite end of the yoke which is to be broached is held in a sliding frame *B*, having a hinged bar at the top to permit inserting and removing the work. The broach is attached to the top of a fixed base *C*, and the slot is cut to the required form as frame *B* and the work are given a circular traversing movement about pin *A*. This movement is obtained by operating handwheel *D* which revolves a screw passing through a nut attached to the movable part of the fixture.

After the yoke is broached, it is transferred to a combination scraping and testing fixture, as shown in Fig. 32. The yoke pivots about the same rocker pin at *A*, and there is a master T-block *D* located at exactly the required radius. This T-block is coated with red lead or some other covering material, and the T-slot is scraped until the yoke is properly

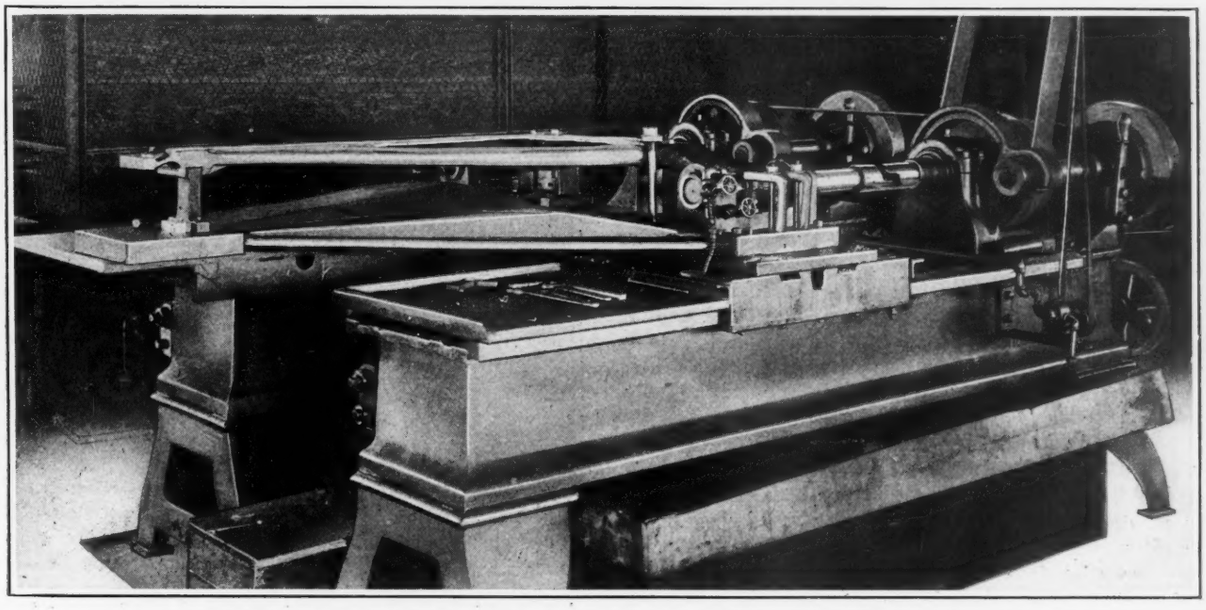


Fig. 31. Duplex Boring Machine for Yoke, made by coupling together Two Engine Lathes

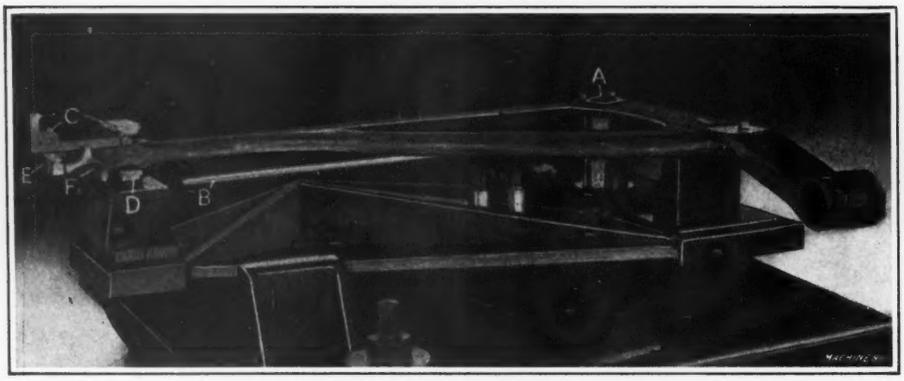


Fig. 32. Scraping and Testing Fixture for Yoke

fitted. The radial position of this T-block is tested frequently to see that no changes occur, and it is held securely by a heavy tie-rod *B*. The type of gage used for testing the position of the end surfaces relative to the T-slot is shown at *C*. The T-shaped block or base enters the slot in the yoke, and the gaging points at the opposite end show the position of the end surface in a vertical direction and of the curved surface in a radial direction.

Reaming and Facing Fixture for Work

As it is essential to have the rocker pin of the yoke located exactly at right angles to some of the other machined surfaces, special provision has been made for finishing the rocker-pin hole. The method of reaming the hole is shown in Fig. 30, the table or plate used for supporting the broaching fixture being employed also for the reaming operation. That side of the yoke which is next to the table has three locating pads which are used for this and other operations and are removed after the yoke is finished. While the yoke is resting on these finished surfaces, the rocker-pin hole is reamed at right angles to them by the reamer *E*, shown in position, which has a pilot that enters a close-fitting hardened and ground bushing in the table. The pin which enters this hole is shown at *F*. The face of the hub or boss must also be exactly square with the hole, and it is finished by the special facing tool shown at *G*, which also has a pilot that enters the bushing in the table. Another tool *H* is also used for facing a shoulder in the counterbored hole.

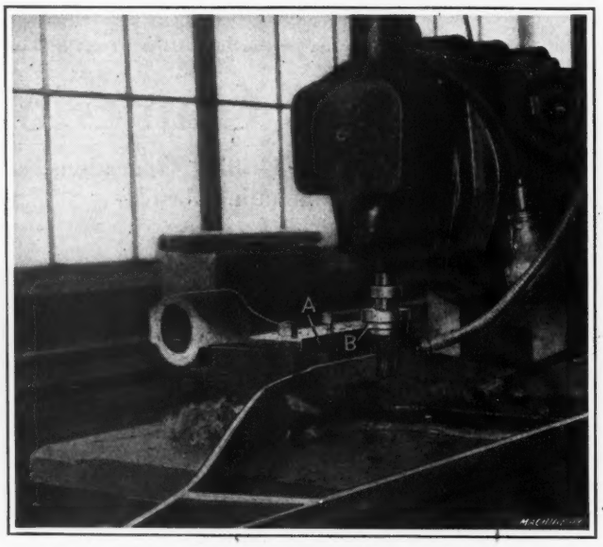


Fig. 33. Illustrating Use of Former Plate for controlling Path followed by Cutter

Milling Cutter Guided by Former Plate

The use of a former or master plate for guiding a milling cutter is illustrated in Fig. 33, which shows the operation of milling the rocker seat in the yoke. The plate *A* is curved to correspond to the curvature of the seat, and on the shank of the cutter there is a roller *B* which is kept in contact with the plate. The lead-screw of the table is removed, and a weight is attached to it to insure holding the roller firmly against the plate.

Boring Holes for Telescope Holders

The holes in the yoke for the telescope holders must be not only accurate as to diameter, but also in exact location and parallel with each other. This operation is performed efficiently as well as accurately by means of a duplex machine, made by simply coupling two engine lathes together as shown in Fig. 31. The lathes are driven by a belt connecting with one cone pulley, and by a short auxiliary belt which leads to the pulley on the headstock of the other lathe. The lead-screws of each lathe are operated simultaneously by a chain and sprocket drive. The work-holding fixture is supported by both carriages and contains bearings for holding the cutter-bars parallel, these bars simply being rotated by the lathe spindle through universal couplings. This is a good example of how standard equipment that may not be required for other work can be utilized to advantage, thus avoiding the expense of special machinery.

After the yokes are bored, as described, each of the bored parts is split along the side to provide sufficient flexibility for clamping the telescope holder. An ordinary cold saw is used for this work, which is much more efficient than a milling machine. The yoke stands in a vertical position on a fixture having two cylindrical pieces which enter the bored holes for the telescope holders.

Cutting Segment Gear Teeth on End of Yoke

The operation of cutting the gear teeth on the end of the yoke is similar to the gear-cutting operation on the sight-bar previously described in connection with Fig. 24 of the second article in the March number (see page 602). The same fixture is used by replacing the adapter which holds the sight-bar with another form designed to support the end of the yoke. As may be seen in Fig. 32, there are spur gear teeth at the extreme end *E* of the yoke and worm-gear teeth at *F*. The spur gear teeth are cut in the same way as described for the sight-bar. The worm-gear teeth are first gashed with a single cutter in the usual manner, and then a hob is used for finishing. The dot-and-

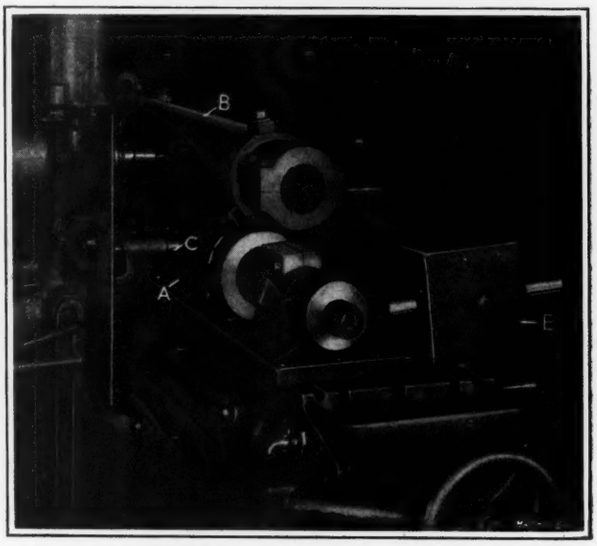


Fig. 34. Fixture for milling Curved Openings in Bronze Recoil Liners

dash lines in the plan view, Fig. 35, show the shape of the yoke and its relation to the fixture. The pin *A*, about which the movable part of the fixture swivels, engages the rocker-pin hole in the yoke and locates it in the right position. This rocker-pin hole is the point about which the yoke is adjusted horizontally, or in azimuth, when the sight mechanism is assembled. The indexing crank of the fixture is shown at *C*. This crank is connected through spur gears with shaft *D* which carries a worm *E*, meshing with a worm-gear segment *F* attached to the swinging member of the fixture.

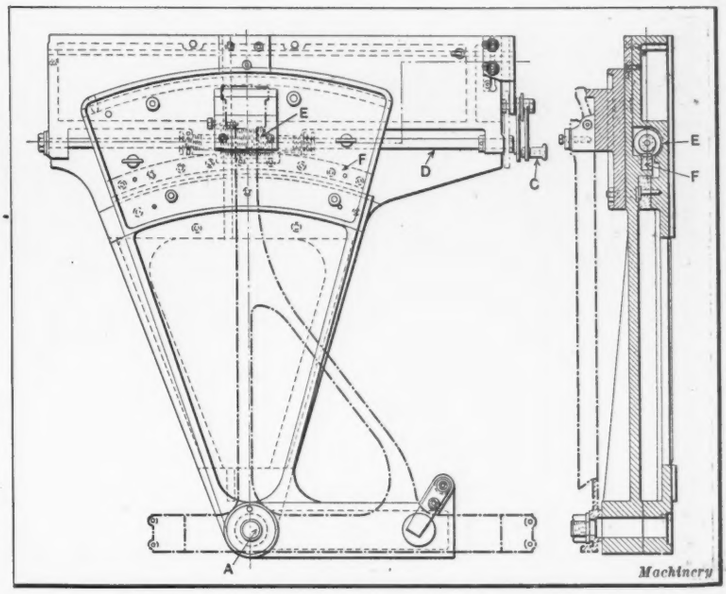


Fig. 35. Plan and Sectional Views of Radial Fixture for cutting Gear Teeth on End of Yoke

Profile Milling Fixture for Recoil Cylinder Liner

An unusual type of milling fixture, and one which proved very effective for a contour milling operation on the bronze liners of recoil cylinders, is illustrated in Figs. 34 and 36. The former illustration shows the fixture set up on a milling machine. This fixture has a master sleeve or former *A* in which there is an opening corresponding to the one to be milled in the recoil cylinder sleeve *B*. A roller *C*, mounted upon a bracket secured to the front of the machine, engages the opening in the former. The master former and the recoil liner are caused to turn in unison by a link *D* which, as clearly shown by the end view, Fig. 36, is connected to the ends of extension arms on the former and work-holding shafts. When milling the lower edge of the opening, which is the operation shown in Fig. 34, the weight *E* is swung over to the right, so that it tends to hold the former firmly in contact with roller *C*. When the machine table is fed in a lengthwise direction for milling this edge, the master former and liner do not have any turning movement, since the lower edge of the opening is straight. For milling the upper or curved side, weight *E* is swung over to the left, and then the curved part of the opening in the master former is held securely against the roller; therefore, when the milling machine table is fed in a lengthwise direction, the former and liner turn in unison as the curved section of the opening is milled. Two lugs on the hub of the weight lever alternately engage a stop as the lever is turned from one position to the other, and in this way either the lower or upper sides in the master former are held against the roller *C*. The liner has a similar opening on the opposite side, which is milled by simply connecting the upper end of link *D* with the opposite end *F* of the double extension arm (see end view, Fig. 36).

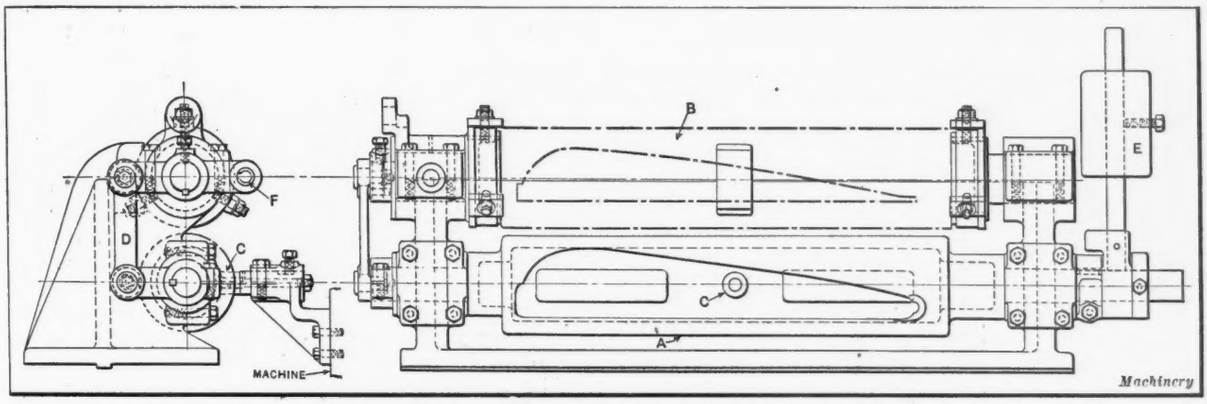


Fig. 36. Front and End Elevations of Milling Fixture for Recoil Liners

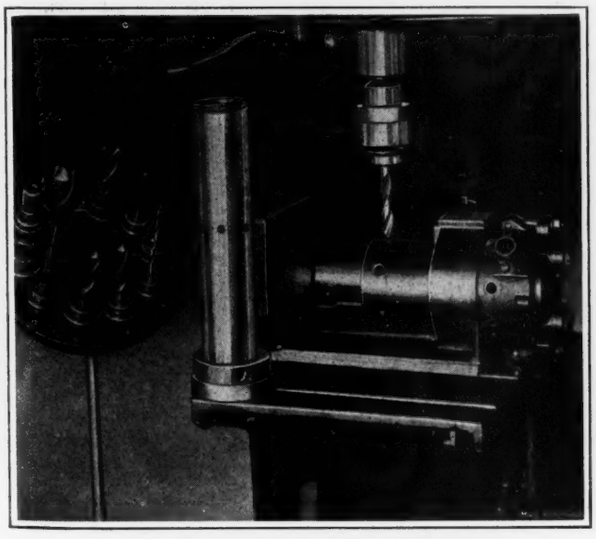


Fig. 37. Indexing Drill Jig for Telescope Holders

Two Examples of Indexing Jig Construction

Jigs of the indexing type are used wherever practicable, so that parts which require the drilling or boring of holes in different positions or at various angles to one another can be finished complete in one jig. An example is illustrated in Fig. 38, which shows a boring jig for the elevating gear bracket. This jig is used to bore the bearings for the gear- and handwheel-shafts. The work is located principally by a horizontal bar *A*. After this boring operation is completed, the fixture is indexed 90 degrees for locating the guide bushing *B* in a vertical position. The fixture has a circular base which is bolted to a corresponding base attached to the table of the machine.

The drilling jig illustrated in Fig. 37 is also of the indexing

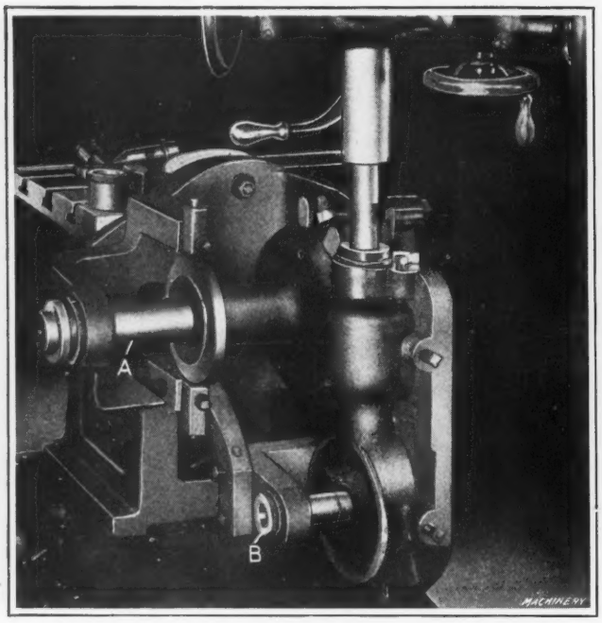


Fig. 38. Boring Fixture for Elevating Gear Bracket applied to a Radial Drilling Machine

Fig. 39. Special Gages for testing Curved Surfaces of Sight-bar Head and Bracket

type, and is used for drilling fifteen holes in the bronze telescope holders. The guide bushings for some of the holes may be seen in the illustration. This jig has a base at the left-hand end so that it can stand in a vertical position for drilling holes parallel to the axis of the holder.

Indexing Milling Fixture for Roller Separator

The bronze roller separators seen in Fig. 40 form part of the roller bearing upon which the carriage turns when training the gun or adjusting it horizontally. These separators have twenty-four holes, and opposite holes must be in alignment and in a radial position, as otherwise there will be a creeping action of the rollers relative to their bearing rings or tracks. A milling machine equipped with a simple type of indexing fixture is used for this work. The base *A* of the fixture is bolted to the machine table and the upper part *B* is free to revolve. This revolving member has accurately spaced holes which are engaged by indexing plunger *C*. After the holes have been drilled and reamed, they are counterbored by the use of suitable tools. The separator rings are located on the fixture by means of the central bore.

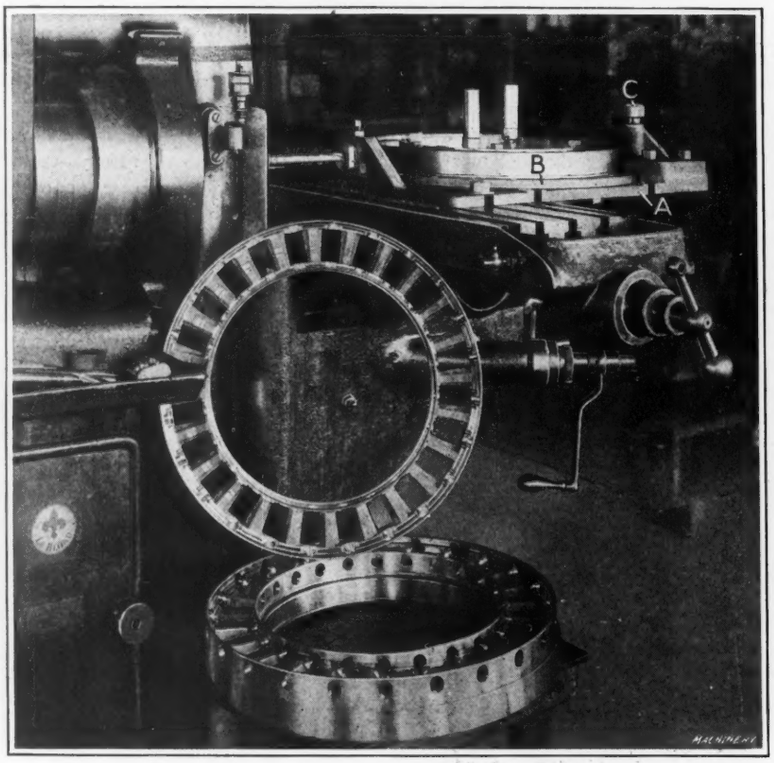


Fig. 40. Fixture for drilling, reaming, and counterboring Holes in Roller Bearing Separator Rings

Testing Accuracy of Machined Parts

A large number of gages of different kinds are required to insure accuracy and interchangeability. Many of these are similar to types used in other branches of work. Two of the special contour or curvature gages used for testing the sight-bar are shown in Fig. 39. The test being demonstrated in this illustration is on the curved edge of the sight-bar head. The gage has a base and a vertical blade which is finished to the radius required. The sight-bar is held in a horizontal position, at exactly the right height, and the surface is tested by inserting narrow strips of tissue paper at the upper and lower ends. This test is not only for the radius, but also for the location of the curved edge. The small angle-plate against which the sight-bar head rests also tests the head for squareness with the sword-bar. Another and larger curvature gage used for the inner side of the sight-bar bracket may be seen at the right.

Fig. 41 illustrates one of the tests made on the slide. This particular test is to determine whether the horizontal bearing for the yoke of the sight mechanism is parallel with the trunnions. An accurate close-fitting shaft is inserted through the bearings and an ordinary dial gage is used. The slide is also turned in an upright position and the same test is applied, so that the accuracy of alignment in both horizontal and vertical planes may be determined.

The shaft about which the yoke swings when in elevation is shown in place in Fig. 42, which also illustrates the method of testing its alignment. It is essential that the different surfaces at each end of this yoke be accurate as to the vertical distance between them. For verifying these vertical distances, a bushing having a flange is

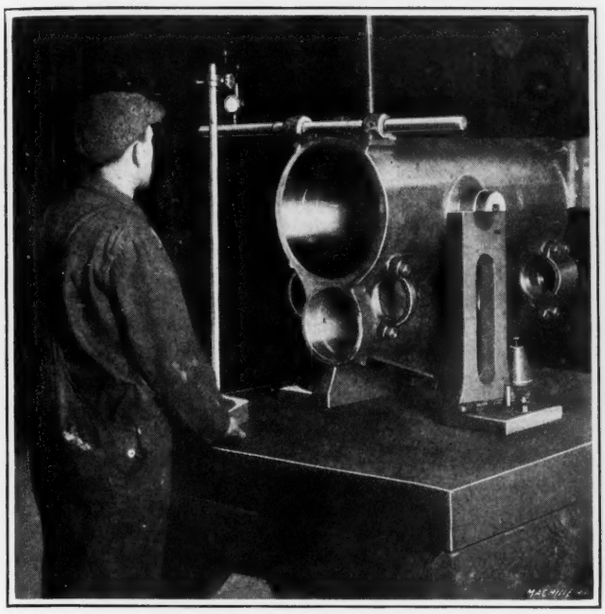


Fig. 41. Testing Accuracy of Alignment of the Slide

Fig. 42. Testing Alignment of Sight-bar Rocker Shaft

placed over the rocker pin before the rocker shown in this illustration is assembled. This bushing fits the rocker pin closely, and the upper surface of its flange is at right angles to the axis of the pin. In making the test, the first step is to set the flange level by means of a dial gage, as the face of the rocker-pin boss is the base from which the other surfaces are located. When the yoke has been leveled in this way, it is a simple matter to measure the vertical distances by the use of a dial gage in conjunction with gage-blocks, which are placed on the different surfaces.

Shop Test for Alignment of Telescope Holders

After the sight mechanisms are completely assembled, they are mounted on testing stands for determining the accuracy of alignment and the parallelism of the telescope holders. The test is made by sighting on the white lines of a target at one end of the shop, and noting any errors that may exist as the sight mechanism is adjusted vertically and horizontally. The target is a blackboard set perpendicular to the axes of the telescopes when the sight is level. Upon the blackboard there is a horizontal line representing a horizontal plane passing through the axes of the telescopes, and two vertical parallel lines spaced the same distance apart as the center lines of the telescopes. When testing the parallelism of the telescopes, the sight is located in such a relation to the target that the line of sight of each telescope coincides with the intersections of the horizontal line and the two vertical lines on the target. The sight is then moved slowly in elevation, while the inspector looks through one of the telescopes, as shown in Fig. 43, to see that the line of sight follows the vertical line on the target. The telescope on the other side is then tested in a similar manner, and without adjusting the sight horizontally or in azimuth. To determine whether the movement in azimuth is at right angles to the movement of the sight in elevation, the sight is brought back to the level position or to a point where the line of sight coincides with the intersections on the target. The sight is then moved to the extreme right- and left-hand positions in azimuth, while the inspector notes whether the line of sight follows the horizontal line of the target. This line of sight is indicated by the cross-lines or wires of the telescope. In order to test the azimuth gearing for lost motion, the sight is moved well to the right, and is brought back slowly until the vertical wire of the telescope exactly coincides with the vertical line of the target, care being taken not to reverse the motion of the gearing. A note is made of the deflection reading on the azimuth plate, and then the sight is run over to the left and slowly brought back until the vertical wire again coincides with the vertical line on the target. The deflection reading on the azimuth plate is again noted, and if it is the same as the preceding one, it shows that there is no lost motion in the gearing. The test for lost motion in elevation is made similarly to that described above, except that the adjustments are made from above and below the horizontal line and the readings are taken in each case when the horizontal line on the telescope corresponds with the horizontal line on the target.

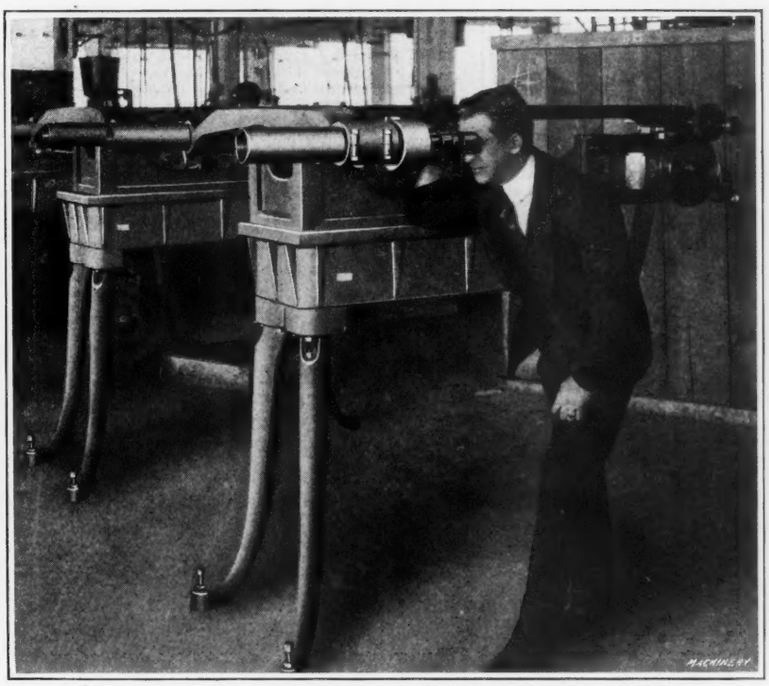


Fig. 43. Determining Accuracy of Alignment and Parallelism of the Sighting Mechanism and Telescope Holders

TURRET FIXTURE AND EXPANSION ARBOR

BY A. J. CAHEN

In the accompanying illustration is shown a turret fixture and an expansion arbor designed for use in turning, facing, and threading the brass tube or hollow cylinder shown in the longitudinal cross-section at *A*. The tube when finished is 13 inches long and has an inside diameter of 2 inches and an outside diameter of 2⅛ inches. An internal thread is cut at *B* and an external thread at *C*, both of which have 20 threads per inch. The requirements specified by the concern for which the parts were made included the reaming of the inside of the tube, the turning of the outside to fit a ring gage throughout its entire length, and the threading of the work to accurately fit male and female gages furnished by the company for which the work was being done. A snap gage was also furnished which was so constructed as to gage the over-all length and at the same time test the parallelism of the faced ends.

First Methods Used in Machining Tubes

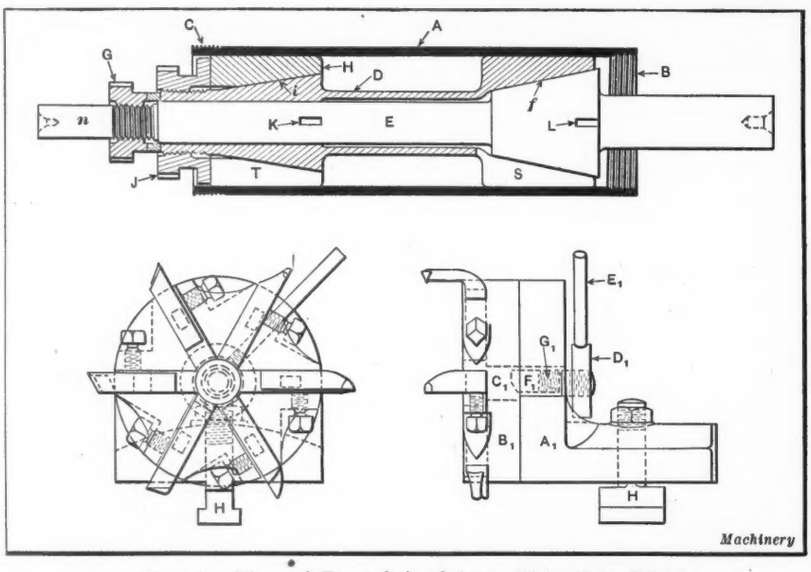
The methods first employed in machining the tubes were as follows: A brass tube of the required diameter was cut into lengths of 13¼ inches and a 2-inch reamer run through each length. One end was then chucked to run true in a lathe and the other end was supported in a steadyrest while being faced and also while chasing the outside thread. This was called the first operation and was followed by a second one in which the chuck was removed and a threaded piece inserted in the lathe spindle to receive the threaded end of the tube. The opposite end of the tube was then faced off to length and the internal thread cut while being supported by the steadyrest.

The rest was then removed, a plug inserted in the tube, and the tail-center brought up to support the work while it was turned to within about 0.01 inch of the required diameter, this amount being left to be removed by the grinder on which the ring gage fit was made. Thus it will be seen that the work was carried through four distinct operations, and as only 70 per cent of the finished product passed the tests for accuracy, the average cost per tube was considered to be too high. Since the order called for the pieces in quantities of 1000, it was found desirable to provide a more efficient method of machining.

Improved Methods of Machining

The fixtures developed, as shown in the illustration, made it possible to finish a tube completely in about forty minutes without removing it from the fixture. The upper view shows the expansion arbor which was made to hold the tube. The mandrel *D* was bored as shown so that the arbor *E* was a close fit in a tapered hole at *f*, and was held in contact with it by nut *G* which is threaded onto the arbor *E*. The bushing *H*, having a tapered hole to fit the tapered end of *D* at *i* was placed in position and secured by adjusting the nut *J* which is screwed onto the threaded end of *D*. Both *H* and the corresponding large end of *D* were then turned down until they were a sliding fit inside the reamed tube *A*. Thus it will be seen that all parts are concentric with the arbor *E*. The tapered holes of the mandrel *D* and of the bushing *H* were slotted at *S* and *T* respectively, as indicated. The pins *K* and *L* were made a sliding fit in the slots and a drive fit in the arbor *E* to prevent the possibility of the arbor turning independently. The ring thread gage for gaging the thread at *C* was hung on the end of the lathe spindle, and the end *n* of the arbor was held in the draw-in chuck.

The tubes, after being cut to length and reamed were slipped over the fixture, allowing sufficient overhang for cutting the thread at *B*. On turning nut *J*, the bushing *H* was forced along the tapered part *i* of the mandrel and expanded firmly against the wall of the tube *A*. The tightening of nut *G* advanced mandrel *D* (and consequently the nut *J*, bushing *H*, and tube *A*) until the tapered hole came into contact with the tapered end of arbor *E*, as at *f*. Thus the taper at *f* forced the mandrel into contact with the tube *A* without in any way disturbing the bearing of the tube at the point of contact with *H*. The pressure at each contact point was then brought to an even tension by adjusting the nuts *G* and *J*. In this way, a means was provided for rigidly holding the tube in position while being turned to the required diameter, faced at each end, and threaded. The concentricity of the finished work when machined on this fixture was found to be nearly perfect.



Expansion Arbor and Turret designed for machining Brass Tubes

The toolpost was replaced in the lathe by the small turret shown in the lower half of the illustration, and held in place by the T-head bolt *H*. The necessary tools for turning, facing, and cutting the internal and external threads were held in the turret as shown. The slotted turret B_1, in which the tools are held, revolves around the bolt C_1 so that the tools are brought into the desired position with respect to the cutting edge and the center of the work, as required. The stop-pin F_1 engages pockets cut in B_1 so that the turret is located in each successive position during the machining operations. The nut D_1, operated by the lever E_1, enables the turret to be firmly clamped to the turret body A_1. The bolt C_1 has a left-hand thread so that the lever E_1 is brought toward the operator when unlocking the turret to allow it to be turned to a new position. When the lever is forced away from the operator the turret is secured in position. The pin F_1, receding in the body A_1 when the tool-head is revolved, is forced out by the spring G_1.

With the outfit described, one operator easily finished twelve tubes a day with a loss through spoiling of less than one-half of 1 per cent, and this small percentage was invariably due to carelessness in cutting the threads too deep. The turret was found to be adapted to several jobs requiring successive tool changing.

* * *

The Bessemer process is generally credited to Henry Bessemer, but in reality it was perfected by David Mushet. After Bessemer had acknowledged failure in obtaining a steel of the proper composition, Mushet solved the problem by removing all the carbon from the molten iron in the converter, and then adding pig iron containing known quantities of carbon and manganese.

LETTERS ON PRACTICAL SUBJECTS

WE PAY ONLY FOR ARTICLES PUBLISHED EXCLUSIVELY IN MACHINERY

FORMING DIES FOR SPECIAL STEEL PINIONS

The making of steel disks like the one shown in Fig. 1 involves the use of forming dies of interesting design, such as were developed at the Craftsman Tool Co.'s plant, Conneaut, Ohio, where these parts are made in large quantities. Cold-rolled bar stock which is drilled and cut into blanks of the dimensions shown at *A*, Fig. 2, is used in making the

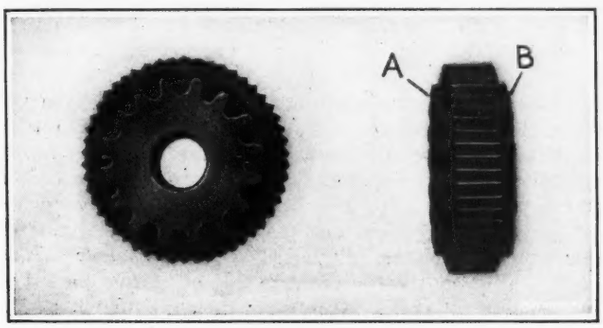


Fig. 1. Steel Disk with Forged Pinions

disks. After the blanks have been heated to a high forging temperature, the pinion sections of the disk, see *A* and *B*, Fig. 1, are formed in a back-geared forging press equipped with the special forming dies shown at *E* and *F*, Fig. 3. The condition of the blank as it comes from the dies is shown at *B*, Fig. 2. After the forging operation has been completed, the blanks are faced to obtain the correct thickness. The saw teeth on the circumference of the disk are then milled in an automatic machine, using a forming cutter which cuts five teeth at a time. In Fig. 2 the principal dimensions of the finished disk are shown in the views of the side and face, at *C* and *D*, respectively.

The tooth sections, or pinions, *A* and *B*, Fig. 1, are formed in special dies which are constructed from steel bolster plates and bored out to receive high-speed steel forming dies *E* and *F*, Fig. 3, in which the internal teeth which form the pinion teeth of the disk have been cut. The upper and lower plungers *L* and *C* serve as strippers for the upper and lower dies. These plungers are constructed to allow for adjustment, and this feature enables the dies *E* and *F* to be ground upon their faces when the teeth become so rounded at the end as not to form perfect teeth in the pinions. By this means, the cost of renewal is kept at a minimum.

In operation, the blank *A*, which has been previously brought to a high forging heat in a furnace, is placed over the pilot *B* so that it rests on the end of the lower plunger *C*. As the slide of the press moves down, plunger *C* and the knock-out rod *D* both travel downward, while the pilot *B* is held stationary by means of a key *M*, which is driven through

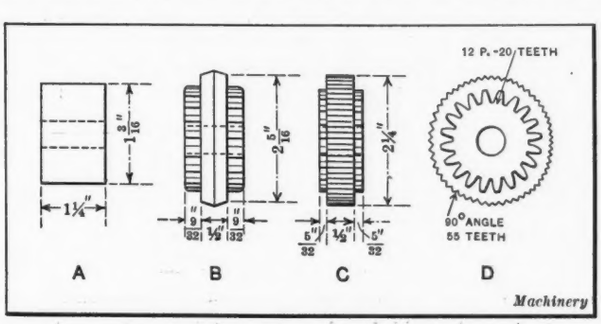


Fig. 2. (A and B) Blank before and after Forging. (C and D) Finished Pinion

and securely held in socket *J*, and which passes through the slot in plunger *C*. The downward movement of plunger *C* is caused by the action of spring *H*, which being held in compression by a pin through the lower end of the plunger, is allowed to expand when the knock-out rod *D* is moved downward. This action, of course, forces the plunger *C* down against the end of rod *D*. The downward stroke of the press slide brings the two high-speed steel dies *E* and *F* nearly in contact, thus squeezing the hot metal blank *A* into the dies and forming the pinion teeth, as shown in Fig. 1. The springs *G* and *H*, shown at the upper and lower ends, respectively, of the plungers, serve to prevent excessive shock when striking against the shoulders in sockets *I* and *J*, that is, the springs *H* and *G* force the plungers to become seated in the sockets before the forming operation takes place. On the upward stroke of the press slide, the knock-out rod *D*

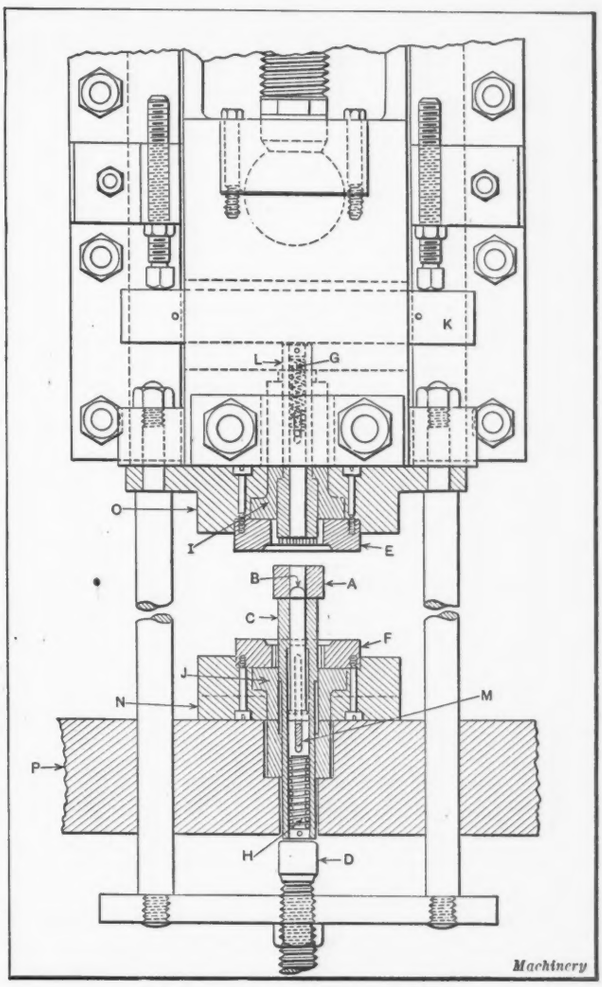


Fig. 3. Special Dies for forming Pinions

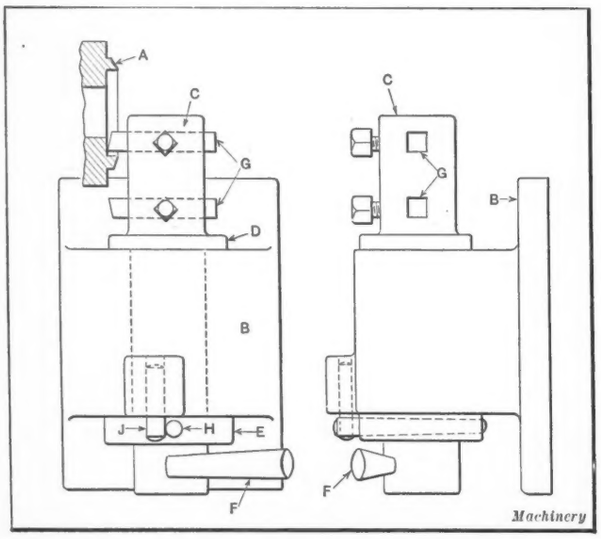
comes into contact with plungers *C*, which strips the blank *A* from pilot *B*. To prevent the blanks from occasional sticking in the top die *E* on the upward stroke, the top knock-out *K* is so located as to come into contact with plunger *L*, thus forcing the blank from die *E*. When the blank comes from the press, the center hole is in perfect condition, due to the accuracy of pilot *B*. Dies *E* and *F* are held in steel die-bolsters *O* and *N* by dowels and cap-screws. A heavy bed-bolster *P* is used to support the bottom die-bolster, and the top die is attached to the press slide.

Conneaut, Ohio F. A. GROSS

EXTERNAL AND INTERNAL FACING TOOLS FOR HAND SCREW MACHINE

Tool designers are frequently handicapped when tooling up the ordinary hand screw machine, on account of the fact that the cross-slide is not mounted on a carriage and therefore cannot be conveniently moved lengthwise on the machine. Consequently the cross-slide of the hand screw machine is ordinarily used for plain external facing and forming only.

A job which could not ordinarily be done on a hand screw machine is shown in the accompanying illustration at *A*. The operation consists of facing and turning both the inside and outside faces and the diameters with a special tool-holder mounted on the cross-slide which is equipped for carrying two tools. Owing to the accuracy required, and also to the fact that a number of tools are used on the turret for other operations, it was thought best to handle the work from the cross-slide in the manner shown. The fixture consists of a cast-iron stand or holder *B* carrying the tool-holder or spindle *C* which is a close running fit in the tool-block. This spindle has a shoulder *D*, and a collar *E* which is fastened by means of a tapered pin *H* to the spindle. The shoulder and the collar bear snugly against the finished



Fixture used on Hand Screw Machine for performing Facing and Turning Operations

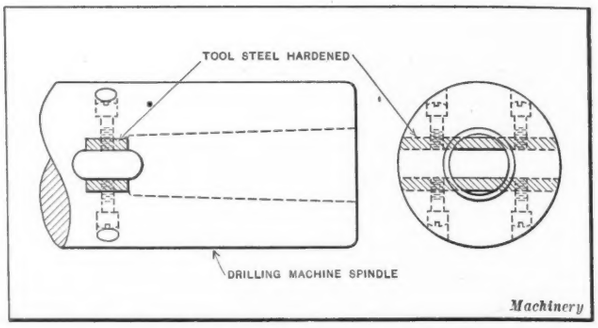
faces of the block *B*, so that there is no end thrust against the spindle. By means of the handle *F*, the spindle can be revolved. The two cutting tools *G* are held in place in the spindle by means of set-screws, as shown. The stop-pin *J* is driven into a boss on the tool-block *B*.

The operation is as follows: The handle *F* is swung over to the right 90 degrees and the cross-slide is moved forward until the tools are brought into the cutting position by turning the handle *F* back to the original position, when pin *H* will come into contact with the stop-pin *J*. Since the position of the tools is thus positively determined, the cross-slide may then be fed forward and backward against suitable stops and the facing or turning cuts readily made. Very accurate results may be obtained with a fixture of this kind.

New York City — DONALD A. BAKER

DEVICE FOR PREVENTING DRILL TANGS FROM BECOMING MARRED OR WORN

The device shown in the accompanying illustration is used to prevent drill tangs from being marred and worn by use in a worn drill spindle. After a drilling machine has been used for a while, the flat sides inside the spindle which grip the drill tang usually become worn and rounded. When in this condition, the drills used in the spindle are often ruined



Method of repairing Worn Drill Spindles

by the corners of the tangs being worn off or twisted, in some cases to such an extent that they have a spiral appearance.

In a certain factory so many tangs on drill shanks were spoiled that it was found necessary to adopt some means of overcoming the trouble. All the large drill spindles were provided with hardened tool steel inserts, as shown in the accompanying illustration, with the result that the tang trouble was at once reduced to a minimum. The grip in the spindle having been made positive, it was found advisable to use drills with shanks which at the large end were not smaller than the diameter of the drills. This necessitated, in some instances, the ordering of drills with larger shanks than those of standard sizes. The rule of having the larger end of the drill shank not smaller than the drill itself insures, in a general way, that the tang will always be as strong as the drill itself. Whether the drill manufacturers would consider this rule technically correct is an open question, but that it is practically correct can be demonstrated in nearly every factory by finding out how many scrapped drills are discarded because of worn or broken shanks.

Springfield, Mass. — D. KIHLGREN

ECONOMY IN THE USE OF REAMERS AND COUNTERBORES

As a matter of economy, more attention could be advantageously given to the disposition of small high-speed cutting tools after they have become worn. Wherever possible, such tools should be manufactured to standard dimensions and types, and should be salvaged after they have become under size through wear.

In a certain plant where many types and large quantities of cutting tools are used, the tool designing and manufacture are under the supervision of a tool engineer. No tools are made until the engineer has investigated and determined upon the proper design that, in his estimation, would give the highest degree of efficiency with the lowest over-all expense. All needless duplication of design is thus avoided, for the engineering department keeps complete records of each tool manufactured.

A few instances of the value of this idea may be of interest. For example, if a straight-fluted reamer of standard size becomes badly worn, it is turned over to the salvaging department and may be used for a special size hole by regrinding the cutting edges and the clearances. A worn 1-inch standard reamer, for instance, might be made to finish a hole 0.995 inch in diameter after being reground in this manner by the salvaging department, and a considerable saving would thereby be effected both in time and in money.

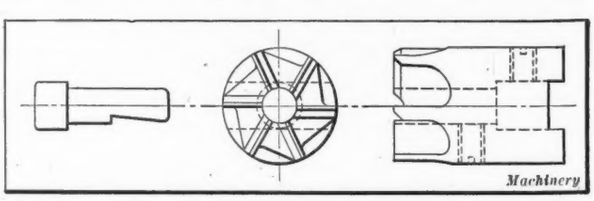


Fig. 1. Counterbore with Interchangeable Pilot designed for Small Work

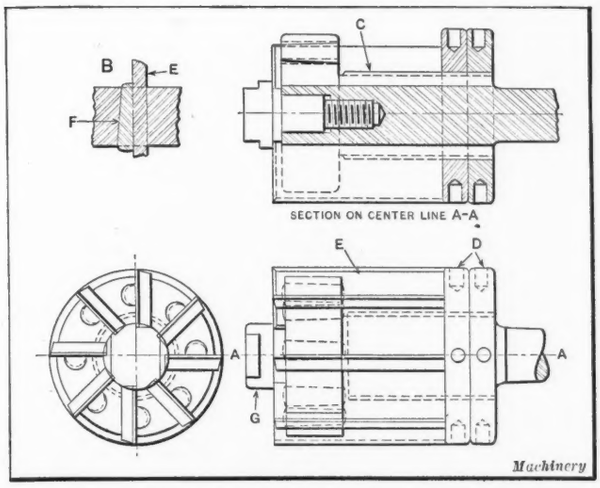


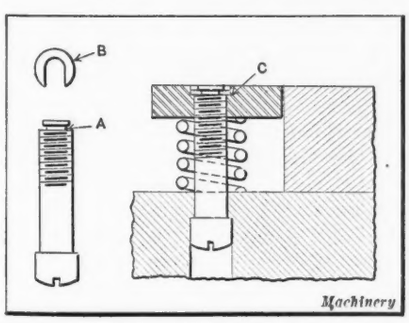
Fig. 2. Inserted-blade Counterbore with Interchangeable Pilot

Sleeves of standard sizes should be kept on hand in the toolroom, to fit the shanks of reamers and similar tools of the same size which have different sized shanks.

The counterbore shown in Fig. 1 is provided with an interchangeable pilot, and will give satisfactory results for ordinary work where the holes are not over 2 inches in diameter. This type of counterbore may be salvaged for use on different sizes of holes, and it may also be made into other forms of cutting tools, such as end- and face-mills. In Fig. 2 is shown the design of an inserted-blade counterbore which is suitable for use on larger work. The body *C* is threaded for the adjusting collars *D*, and slotted to take the cutters *E*. The body and collars are made of machine steel and the blades of high-speed steel. The blades are held in the body by means of the familiar wedge-pin construction, illustrated in the sectional view at *B*. The pins *F* are made of cold-drawn steel, or drill rod, and are milled flat on one side. Pilot *G* is interchangeable and is made from tool steel, only the teat being hardened. The pilot may be conveniently removed when it is desired to regrind the blades. When it becomes necessary to reset the blades, after several grindings, the tapered pins *F* may be readily removed and the blades adjusted by means of the collars *D*. Before replacing the pilot, the end of the blades should be faced. A tool of this design is simple, efficient, and economical, and one set of blades alone will outwear several counterbores of the one-piece high-speed steel type. F. R. B.

LOCK-WASHER FOR STRIPPER SCREW

The following method is suggested as a means of locking the screws of a spring-operated stripper plate so that they will not jar loose while the press is in operation. If a shouldered screw is used, the continual pounding of the punch press causes the screws to work loose, and if the ordinary fillister-head screw is used, it will do the same thing if the end is not turned over. When it becomes necessary to grind or repair the punch, there is no means of removing a battered screw without injuring the threads in the stripper plate. However, the screw shown in the accompanying illustration has been found to overcome these difficulties successfully. As will be seen, a small groove *A* is cut about 1/32 inch from the end of the screw, and a yoke washer *B*, having an outside diameter slightly smaller than the counterbored hole in the stripper plate, is made to fit the groove in the bolt. When assembling the stripper, the screws are run through far enough to allow the washer to be slipped into the groove. The screw is then backed out until the washer comes in contact with the bottom of the counterbored hole, as shown at *C*. A very thin washer is all that is necessary, as the threads in the stripper and screw take the pressure of the spring, while the washer only serves to prevent the screw from backing out.



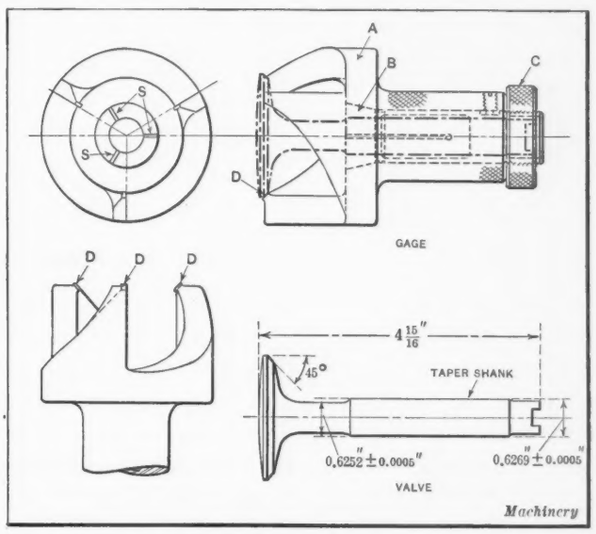
Lock-washer for Stripper Screw

Dayton, Ohio CHARLES M. BREHM

CONCENTRICITY GAGE FOR VALVE

The accompanying illustration shows a type of valve which is used extensively on airplane engines. The valve shank or stem is tapered, as indicated by the dimensions, because the smaller end which is located nearer the hot combustion chamber in the cylinder expands more and therefore requires greater clearance. The gage shown in the illustration was designed to test the concentricity of the valve seat with the tapered stem.

The gage consists of three principal parts: the body *A*, the spring collet *B* and the knurled hand-nut *C*. The body has three 45-degree gaging faces *D*, which are spaced 120 degrees apart. These faces are relieved similarly to a hollow-mill, and are ground concentric with a hole in the body. The spring collet is assembled into this hole, and is adjusted by turning the knurled screw *C*, by means of which the stem of the valve is held as the collet is contracted. The collet is slotted on the end to allow for this contraction, as shown at *S*, and is held from turning in the gage by a set-screw as shown. It is also threaded on the extreme end to take the hand-nut *C*. When the valve is placed in the gage, preparatory to being tested, the collet is loose and the stem slides snugly into the hole in the gage. When the hand-nut is tightened, the collet grips the valve stem tightly at the small end. If the valve seat rests on the three gaging faces *D* without any light showing through, the stem is concentric with the seat within the required limits of accuracy.



Airplane Engine Valve and Gage for testing Concentricity of Tapered Shank with Valve Seat

New Brunswick, N. J. C. H. DENGLER

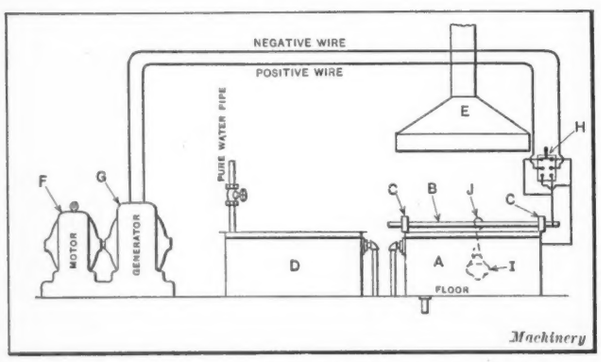
CLEANING METAL SURFACES

The following is a description of a process for cleaning metal surfaces, which employs an electric current and a solution of caustic soda. It is claimed that by this process the metal parts can be thoroughly cleaned in a few seconds without producing any injurious effect on the metal. After several laboratory experiments and trials, this system was

installed in two plants in each of which it is giving satisfaction at the present time, and is superseding the methods previously used. The metal was formerly cleaned at these plants by heating an acid bath, using steam pipe coils. This method was unsatisfactory, requiring considerable time, since the acid was found to have destroyed or eaten the incrustments of foreign matter too slowly.

As shown in the accompanying illustration, the new equipment consists of a tank *A* which is made of sheet iron, reinforced by 1½-inch angle-irons. A copper tube *B*, about 1 or 1½ inch in diameter, is supported just above the top of the tank by wooden blocks *C* provided with bushings made from rubber hose, so that the copper tube is insulated from the iron tank. The size of the tank and the thickness of the sheet iron from which it is made depends upon the requirements of the work to be done. The quenching tank *D*, which is used to remove the acid from the work when the cleaning process is completed, should be about the same size as tank *A*. The sheet-iron hood shown at *E* is fitted with a pipe so that the fumes from the tank *A* are carried away. At *F* is shown an induction motor designed for either 110 or 220 volts, which is coupled to a direct-current generator *G* capable of generating from 6 to 8 volts at 2000 amperes. The positive wire from the generator is connected to the tank, and the negative wire to the copper bar *B* when the system is in operation. However, a double pole and double-throw switch *H* is so connected with the circuit that the current can be reversed when desired for the purpose of cleaning the tank when it becomes incrusted. An ordinary rheostat is, of course, used for regulating the current.

In operation, the tank *A* is filled with a solution made of from 4 to 8 ounces of caustic soda to a gallon of distilled or boiled water. The piece to be cleaned, represented by *I*, is suspended from the bar *B* by a brass hook *J* and the current is turned on. When small articles are to be cleaned, they may be placed in a wire basket and suspended from the hook. As soon as the material has been cleaned, it should immediately be removed from the bar and placed in the quenching tank *D* which is filled with pure water, to stop the action of the acid. The pieces can then be removed and dried. If any scale or deposit is found on the tank after the material has been removed, the switch *H* is reversed and the electrostatic induction action employed to remove the scale from



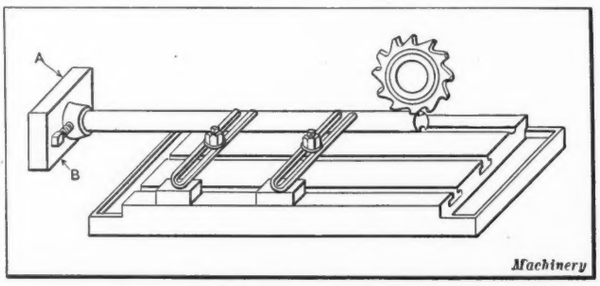
Equipment used for cleaning Metal Surfaces by Means of an Electric Current

the tank. After this current has been passed through the tank for a few seconds, the drain cock in the bottom of the tank should be opened to allow the sediment to be carried away. A fresh solution should then be made and placed in the tank.

Detroit, Mich. C. C. SPREEN and G. V. H. CAIRNS

ACCURATELY LOCATING KEYWAYS ON OPPOSITE SIDES OF SHAFTS

In the accompanying illustration is shown a device for locating shafts while keyways on opposite sides are being milled. It consists of a head with the surfaces *A* and *B* machined parallel, and a level which is applied to the uppermost surface so as to locate the shaft in position before it is clamped to the table. This head is attached to the shaft as shown while the first keyway is being cut; when locating the shaft for the second cut, it is merely necessary to turn the opposite surface up, and by leveling this properly, without changing the other adjustments, the shaft is quickly placed in the proper position for milling the opposite keyway. It is also apparent that after shifting the table, if the shaft is again clamped level, a much straighter keyway will result than if the machine is depended upon to center the shaft. There are usually three reasons for winding or crooked keyways: the table may be set a little off the zero mark; some irregularity may exist in the cutter, which makes one



Arrangement for holding Shafts when milling Opposite Keyways

side cut easier than the other; or the action of the clamps may be sufficient at times to move the shaft slightly.

By using a hexagon or octagon shape at the end of the shaft, it will be possible to cut either six or eight keyways in exact relation to each other without the use of a dividing head. An important advantage of this device is the accuracy with which a shaft can be aligned after each clamping, resulting in cutting straight and accurate keyways.

Evanston, Ill. I. H. SPOOR

SAVING TIME IN COUNTING SCREW MACHINE PRODUCT

On hand screw machine work, where large quantities of pieces are machined in a day, a great deal of time is lost by operators who are working by the piece, in counting the work at the close of the day. One of the employes in our screw machine department overcame this difficulty and consequently added to his pay check by purchasing a small counter and attaching it to his machine. A bracket was made to hold the counter, which was bolted to the end of the feed-bar rest. A piece of light chain was used to connect the tripper of the counter with the chucking handle of the machine, so that on every full forward movement of the chucking handle the tripper would operate and register a count. In order to make a count, however, a full forward movement of the handle was required, thereby eliminating the registration when a piece of work was spoiled before being completed. The workman could thus open his chuck at will without registering a count. Other employes, seeing the advantage of this simple device, immediately followed his example and applied a counter in a similar manner.

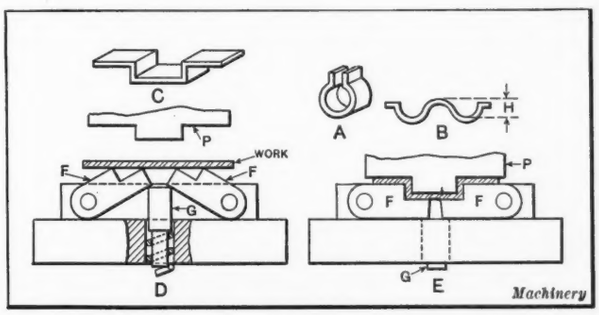
Aurora, Ill. J. J. BORKENHAGEN

[The above is an instance where a general increase in production was effected by a simple device introduced individually by an employe. It would be of value to the management of a manufacturing plant to watch for these little time-savers and introduce them generally in the plant, instead of leaving matters of this kind to the employes themselves. The incident recalls a case relating to the introduction of high-speed steel in a large machine-building plant some fifteen years ago. The management discovered by examining the payroll, that one of the piece-workers was earning an exceptionally high wage. Upon investigation, it was found that the reason for this was that this man had, at his own expense, provided himself with high-speed steel tools. Previous to this discovery, salesmen of high-speed steel had been

unable to get a hearing from the company's purchasing agent, but after the practical demonstration provided by one of the employes, high-speed steel tools were furnished by the firm wherever they could be used to advantage throughout the shop.—EDITOR]

SHAPING SHEET-METAL PARTS

It is frequently required to make a formed sheet-metal collar similar to that shown at *A* in the accompanying illustration. This piece can be easily formed in one operation if the quantity of pieces required is sufficient to warrant



Simple Punch and Die Equipment for Sheet-metal Work

the manufacture of an expensive forming punch and die equipped with side-acting cams. However, if such expense is not warranted, the following method can be used: A forming punch and die is made to form the blank in the first operation to the shape shown at *B*. The dimension *H* should be made slightly greater than one-half the outside diameter required for the finished piece. This dimension will vary, depending upon the quality of the stock. After forming, the piece is shaped by a punch having a removable pin around which the collar is shaped by pressing the formed piece into a U-shaped die. These simple devices are very inexpensive tools to make.

Another shape that is often troublesome to form in one operation is that shown at *C*. This and similar shapes are frequently required in large quantities. For performing this operation, the punch and die shown at *D* and *E* are used. The construction is simple and inexpensive. At *D* the forming dies *F* are shown raised by the action of the spring plunger *G* and supporting the work previous to starting the forming operation. At *E* the punch *P* has descended and formed the piece, the plunger *G* having been forced down. On the upward stroke of the punch the spring which controls the plunger forces it up and ejects the work.

Chicago, Ill. C. W. HINMAN

WEIGHT OF STEEL SHAFTING

In purchasing rolled or drawn steel bars for shafting, difficulty is often experienced due to the fact that some dealers quote a price per foot, while others quote a price per pound. For convenience in making rapid comparisons of prices which are given in both ways the writer has evolved the following rule for obtaining the weight per foot when the diameter is known, which may be easily remembered and applied:

Square the number of sixteenths of an inch in the diameter of the shaft, point off two places from the right, and the result will be the approximate weight per foot in pounds. This result will be about 4 per cent under, and a close approximation can be obtained by increasing the value found by 4 per cent.

Example—The approximate weight of 1 15/16-inch diameter shafting would be

$$(16 + 15)^2 = 31^2 = 9.61 \text{ pounds per foot}$$

To get a closer value add 4 per cent of this, or about 0.38 pound. The result thus obtained is 9.99 pounds per foot; MACHINERY'S HANDBOOK gives the weight as 10.02 pounds per foot, so it will be seen that the rule stated in the foregoing gives a close approximation.

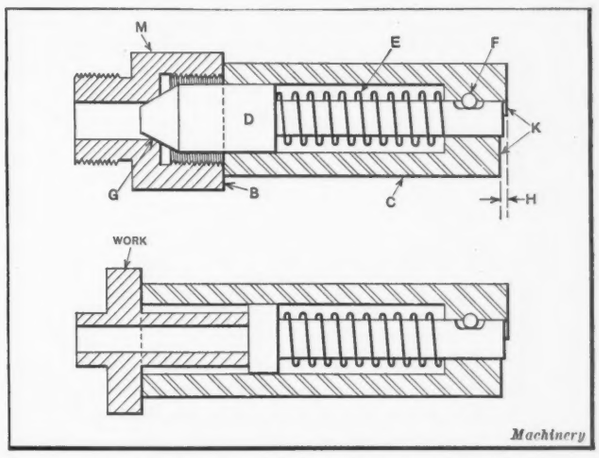
Rochester, N. Y. GEORGE C. HANEMAN

FLUSH-PIN GAGES

The extensive use of flush-pin gages by munition manufacturers during the war has naturally resulted in the development of many different methods of constructing gages of this type. As the flush-pin gage has been found practicable for the rapid gaging of work where the tolerance is as small as 0.003 inch, it is evident that it must be accurately machined. The two gages shown in the accompanying illustration are of excellent design, and can be made at a lower cost than a great many of the gages which are designed for the same or similar purposes..

The flush-pin gage shown in the top view is used for gaging the work *M* which requires that the tapered portion of the hole shown at *G* shall be kept at a certain distance from the face *B* within a close limit of accuracy. The gage, as will be seen from the illustration, consists of a body *C* in which is fitted the plunger *D*. The large end of the plunger is carefully ground to fit the taper in the work at *G*, while the small end is cut off and finished to the required length, that is, so that it will be located between the two steps that indicate the tolerance shown by *H* when the work *M* is properly machined. The pin *F* prevents the gage from becoming disassembled and limits the travel of the plunger to about 1/32 inch either way. The plunger is normally held in the extended position by the action of spring *E*. When the gage is in use the tapered part of the plunger is brought into contact with the tapered hole in the work at *G*. The face of the gage is then forced against the face of the work at *B*. If the work is properly machined, the small straight end of plunger *D* will be located between the steps *K* which determine the tolerance *H*. This gage can also be adapted for use in gaging the depth of blind holes and recesses by machining the large end of plunger *D* to the required size.

The gage shown in the lower view of the illustration is of similar construction to that shown above but it is used for



Flush-pin Gages for External and Internal Gaging

external gaging. The method of using this gage is the same as for the internal gage.

Newark, N. J. GEORGE E. MAHER

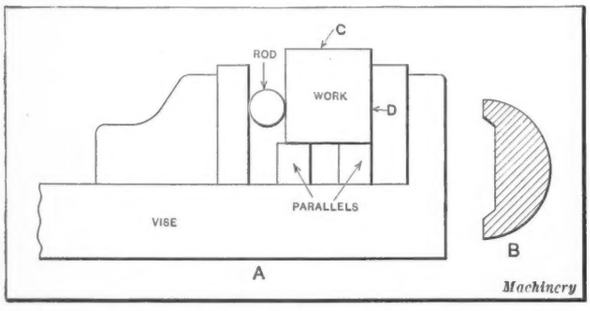
* * *

It has been found, by an investigation conducted by the Bureau of Standards to determine the temperature limit and periods of annealing necessary for the elimination of initial stress in different compositions of brasses, that in rods of simple section, initial stresses, producing season cracking, are most readily eliminated by the process of springing, such as by rolling in a straightening machine. This method, however, cannot be applied to articles of irregular shape, stampings, etc.

SHOP AND DRAFTING-ROOM KINKS

IMPROVED VISE CLAMP

In the accompanying illustration at *A* is shown the usual method of holding a piece of work in the vise of a milling machine or shaper when it is desired to finish the top surface *C* so that it will be at right angles to the surface *D*. The use of the round rod enables the previously finished surface *D* to be firmly clamped to the stationary jaw of the



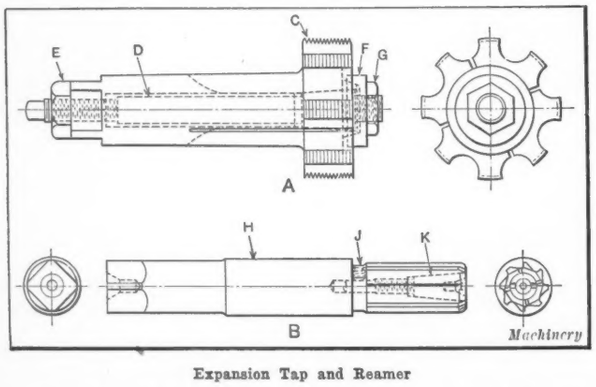
Improved Method of holding Work in Vise

vise. As the face of the stationary jaw is at right angles to the path of the cutting tool, it is evident that the surface *C* will be machined at right angles to the surface *D* when the work is held in the position indicated. However, in setting up the work it is sometimes difficult to keep it firmly seated on the parallels, as the round rod often causes a rolling action which displaces the work when tightening the vise. This trouble can be overcome by using a rod having a cross-section like that shown in the enlarged sectional view at *B*, in place of the round rod. This piece can be very easily made from round stock.

Baltimore, Md. S. B. ROYAL

EXPANSION TAP AND REAMER

A hand sizing tap which has been found very effective on airplane motor work in bringing tapped holes to fit standard gages is shown in the accompanying illustration at *A*. If, after the holes have been rough- and finish-tapped, they are still found to be under size, the hand sizing tap is run in



Expansion Tap and Reamer

and the desired tolerance thus obtained. The design of the tap is simple, the shank and all other parts except part *C*, which is made of tool steel, being made of ordinary machine steel. The part *C* is a regular milled tap provided with four slots which allow it to be expanded by a tapered plug *D* that is screwed in and locked by the nut *E*. When adjusted to the required size, the tap is locked by means of the tapered bushing *F* which is secured in place by the nut *G*. The construction should be apparent by reference to the illustration.

Another hand tool is shown at *B*. As will be seen, this is an adjustable hand reamer provided with a ground pilot *H* and a screw *K* having a tapered portion which is used to produce the expansion, the reamer containing four slots, as shown, to allow for the expansion. The screw *K* is locked by a small set-screw *J*.

New Brunswick, N. J. C. H. DENGLER

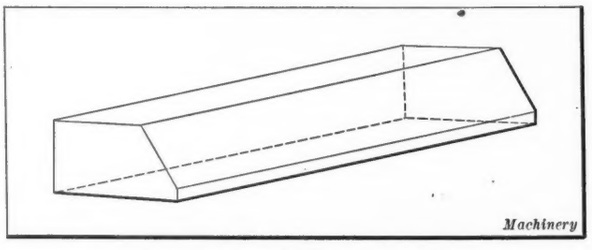
DRAFTING-ROOM KINK

In the making of tracings, much of the tedious work of lettering may be avoided by placing some of the firm's printed matter, such as letter heads, bill heads, printed envelopes, etc., beneath the tracing cloth. A surprisingly large amount of the data required in the lower right-hand corner of a drawing may be directly traced from this printed matter, thereby eliminating the work of measuring the letters and saving considerable time.

New York City E. J. HIGGINS

HOLD-DOWN BLOCK FOR MACHINE VISES

An inexpensive and satisfactory hold-down block for use in a machine vise, such as is regularly used on a shaper or milling machine, may be made from hard wood. For ordinary purposes, a piece of hard wood about 1 foot long, having a 1-inch square section and one side beveled, as shown in the



Wooden Hold-down Block for Machine Vises

accompanying illustration, will be found satisfactory. However, in some cases it may be found necessary to shape the block to conform to the contour of the work which is to be held, or for an exceptionally irregular casting it may be advisable to use a hold-down block at each side of the casting. In all cases, the surface or edge of the block which comes in contact with the work should be beveled so as to grip the piece near the bottom. With these hold-down blocks properly placed between the work and the vise jaws, it is unnecessary to employ a hammer to drive the work down, as the downward pressure exerted by the beveled blocks properly seats the piece. The writer has used wooden hold-down blocks in the manner described for a long time and they have given very satisfactory results.

Yonkers, N. Y. EUGENE BILGER

GUIDES FOR DRAWING GEAR TEETH

A simple set of guides for drawing gear teeth may be made by tracing the profiles of the different sizes of gear teeth from MACHINERY'S HANDBOOK or from the catalogues of gear manufacturers. These tracings may then be pasted on pieces of celluloid or wood, as for instance, on old triangles or protractors, and the guides formed by cutting out the profiles with a scroll saw. If no pieces of celluloid are at hand, cigar-box wood will be found satisfactory, as it is fairly strong and warps very little.

Bloomfield, N. J. WILLIAM PHILIP

HOW AND WHY

QUESTIONS ON PRACTICAL SUBJECTS OF GENERAL INTEREST

METHODS OF OBTAINING LENGTH OF BELTS

L. M. S.—How can the lengths of open and crossed belts be determined when the only known dimensions are the diameters of the driving and driven pulleys and the distance between their centers?

Answered by F. C. Duston

Nearly every technical handbook contains formulas that may be used in determining the theoretical length of belts when the diameters of the pulleys and the distance between their centers are known. While in most cases these formulas give sufficiently accurate results for use in obtaining the approximate length, they do not give the exact length of belt which would be necessary to transmit the power with the highest degree of efficiency. In fact, it would be practically impossible to obtain a formula which could be satisfactorily applied in every case, as there are so many factors to be taken into consideration. The following formulas give the theoretical length of belt required, and make no allowance for factors of stretch or sag, nor for the thickness of the belt. The variation in length imposed by these factors cannot be easily determined, even when the exact nature of the drive and kind of belt to be used are known.

In practice, parallel clamps are usually employed in fitting large belts for drawing the belt ends together, thus enabling them to be joined while under tension. Some manufacturers of rubber belting make belts which are ⅛ to ¼ inch per foot shorter than the distance around the pulleys, as measured with a tightly drawn steel tape. Referring to Fig. 1, D and d represent the diameters of two pulleys with a distance between centers equal to X. By disregarding the sag, thickness, and elasticity of the belt, the problem becomes one of simple trigonometry and may be solved as follows:

Open Belt

Let AL and AF be drawn to the point of tangency of LH and FJ, respectively; then the arc LMF represents the arc of contact that the belt makes with the larger pulley. Let BH and BJ also be drawn to the point of tangency of LH and

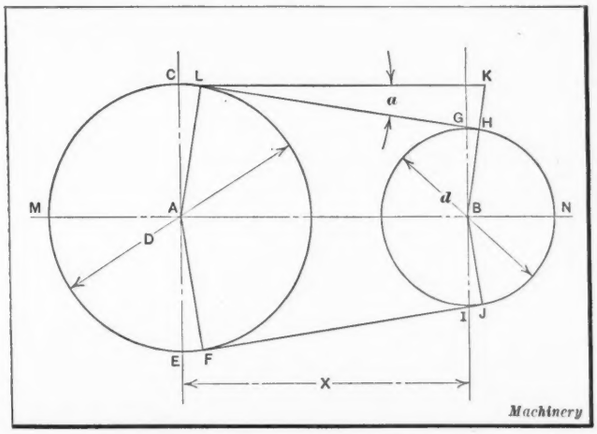


Fig. 1. Diagram illustrating Method of obtaining Length of Open Belt

FJ. The arc HNJ will then be the arc of contact which the belt makes with the smaller pulley. Now let BH be produced indefinitely and line LK be drawn parallel to center line MN through point L so that it will intersect BH produced at K. Angle a equals the angle formed by LH and MN, and it also equals angles CAL and GBH. Now the belt may be considered to be composed of six sections, the sections covering arcs CME, CL, EF, and HNJ, and the sections LH and FJ. To simplify the process, one-half the length of the belt is found first, which is represented by arcs ML, HN, and the section LH. We then have:

$$\text{Sin } a = \frac{\frac{1}{2}(D-d)}{X}$$

$$ML = \pi D \frac{90+a}{360} \qquad HN = \pi d \frac{90-a}{360}$$

$$LH = X \cos a$$

Adding ML, HN, and LH we have:

$$\pi D \frac{90+a}{360} + \pi d \frac{90-a}{360} + X \cos a =$$

$$\frac{\pi (D+d)}{4} + \pi (D-d) \frac{a}{360} + X \cos a$$

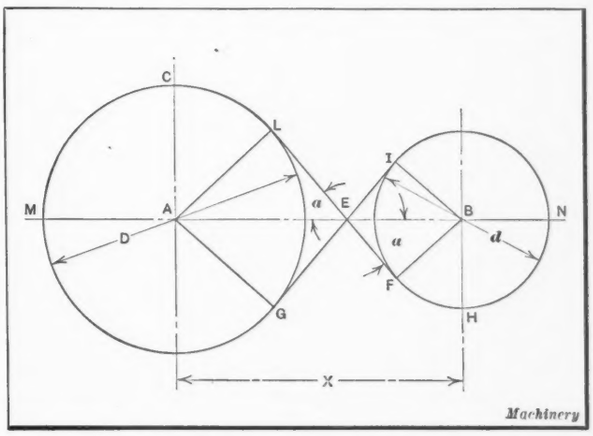


Fig. 2. Diagram for obtaining Length of Crossed Belt

from which one-half the length of the belt can be found; or the total length of the belt can be determined directly by using the formula:

$$\frac{\pi (D+d)}{2} + \pi (D-d) \frac{a}{180} + 2X \cos a$$

Crossed Belt

Fig. 2 represents two pulleys connected by a crossed belt as indicated. As in the case of open belts, D and d represent the diameters of the large and small pulleys, respectively, and X the distance between their centers. By drawing lines from the centers of each circle to the point of tangency of the lines LF and GI, which represent sections of the crossed belt, it is found that LMG is the arc of contact on the larger pulley and INF, that on the smaller pulley.

$$\text{Sin } a = \frac{\frac{1}{2}D}{EA} = \frac{\frac{1}{2}d}{EB} \qquad \text{Sin } a = \frac{\frac{1}{2}(D+d)}{X}$$

$$LE = \cos a \times AE \qquad EF = \cos a \times EB$$

$$LE + EF = \cos a\,(AE + EB) \text{ or } LF = X \cos a$$

$$MCL = \pi D \frac{90+a}{360} \text{ and } FHN = \pi d \frac{90+a}{360}$$

Then by adding MCL, LF, and FHN, we have:

$$\pi D \frac{90+a}{360} + X \cos a + \pi d \frac{90+a}{360} =$$

$$\frac{\pi (D+d)}{4} + \pi (D+d) \frac{a}{360} + X \cos a$$

from which one-half the length of the belt can be found, or the total length can be determined by the formula:

$$\frac{\pi (D+d)}{2} + \pi (D+d) \frac{a}{180} + 2X \cos a$$

SIMPLIFIED FORMULAS IN GEARING

E. M. E.—If the center distance of two gears is known, and also either the revolutions per minute, the number of teeth, or the gear ratio, how can a simple formula be derived for finding the pitch diameter of each gear?

Answered by William F. Jones, Arlington, N. J.

Referring to the accompanying illustration, the number of teeth in both gear and pinion being known, then the diametral pitch of the gear is $\frac{a}{D}$ and the pinion is $\frac{b}{d}$; where,

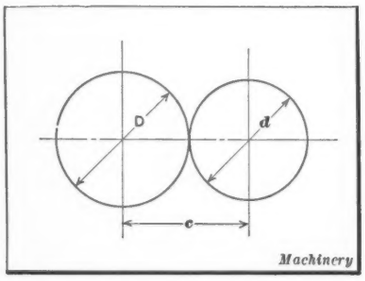


Diagram Illustrating Use of Formulas for finding Pitch Diameter of Gears

a = number of teeth in gear (or revolutions per minute of pinion);

b = number of teeth in pinion (or R. P. M. of the gear).

The center distance c, as defined in MACHINERY'S HANDBOOK, may then be expressed by either of the following two formulas:

$$c = \frac{a+b}{2\,(a \div D)} \text{ or } c = \frac{a+b}{2\,(b \div d)}$$

Simplifying these expressions,

$$c = \frac{a+b}{2\,(a \div D)} = \frac{D\,(a+b)}{2a}$$

$$D\,(a+b) = 2ac \qquad D = \frac{2ac}{a+b} \qquad (1)$$

$$c = \frac{a+b}{2\,(b \div d)} = \frac{d\,(a+b)}{2b}$$

$$d\,(a+b) = 2bc \qquad d = \frac{2bc}{a+b} \qquad (2)$$

It will be necessary to use one of these two formulas for finding the first pitch diameter, after which, having found the value of either D or d, a simpler formula may be used, by adding Equations (1) and (2) and simplifying thus:

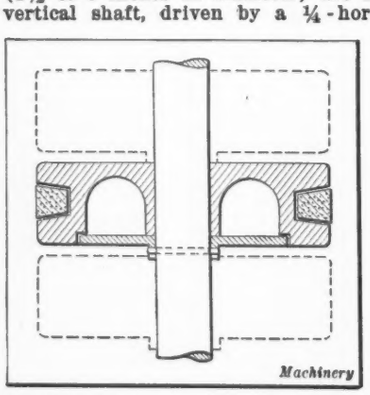
$$D + d = \frac{2ac + 2bc}{a+b} = \frac{2c\,(a+b)}{a+b}$$

Cancelling, $D + d = 2c$

Then, $D = 2c - d$ or $d = 2c - D$.

CLUTCH DESIGN FOR CLOSELY SPACED SHEAVES

R. L. C.—In a space 6 inches in height, six small sheaves (2½ to 5 inches in diameter) are mounted upon a ⅝-inch vertical shaft, driven by a ¼-horsepower motor, at 175 revolutions per minute. These sheaves must be operated independently by friction clutch mechanisms moved radially in relation to the shaft. The accompanying illustration shows the smallest sheave (2½ inches in diameter) and a possible arrangement for the sheave and the part keyed to the shaft. What is the proper design for a clutching mechanism operated by a short radial movement in the ⅛-inch space available between the sheaves?



Vertical Shaft and Closely Spaced Sheaves for which Clutches are required

This question is submitted to the readers of MACHINERY.

A TOOLMAKER'S PROBLEM

J. A.—Will you kindly show me how to find the correct diameter of a plug which will be tangent to the sides of a snap gage as shown in the illustration? The 2-inch dimension and the 15-degree angle are all that are known.

Answered by Max Silver, Plainfield, N. J.

The following solution is, perhaps, simpler than that given in the February number of MACHINERY on page 551. In the accompanying diagram, angle CAB = 90 degrees + 15 degrees = 105 degrees. Angle DOE + angle CAB = 180 degrees. Therefore angle DOE = 180 − 105 = 75 degrees. Since line OA bisects angle DOE, angle a = ½ × 75 = 37 degrees 30 minutes.

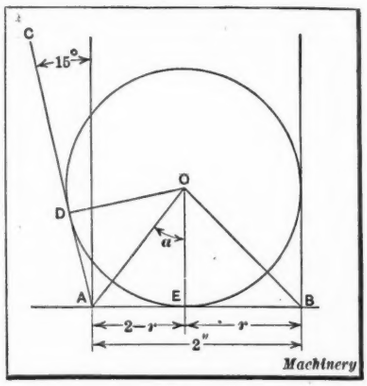


Diagram for Use in Solution of Toolmaker's Problem

$$\frac{2-r}{r} = \tan 37 \text{ degrees } 30 \text{ minutes}$$

$$r\,(\tan a + 1) = 2 \qquad r = \frac{2}{\tan a + 1}$$

$$\tan a + 1 = 1.76733$$

Therefore,

$$\frac{2}{1.76733} = r = 1.13165 \text{ inch, and } 2r = 2.2633 \text{ inches.}$$

Answered by Elmer Latshaw, West Philadelphia, Pa.

The following method is simple and involves the solution of but one right-angle triangle. Referring to the accompanying illustration, erect FO perpendicular to AG, CO perpendicular to AE, and DO perpendicular to AB. Draw AO, which, according to geometry, bisects the angle COD. Angle FOC = EAG = 15 degrees. Angle COD = 90 − 15 = 75 degrees.

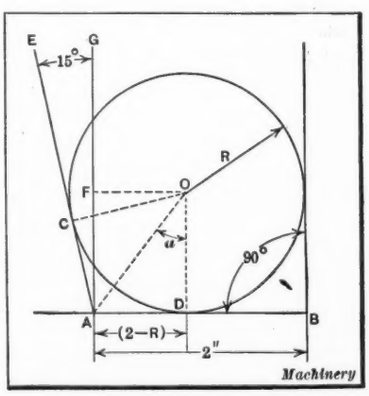


Diagram for Use in Solution of Problem

$$\text{Angle } a = \frac{\text{angle } COD}{2} = \frac{75}{2} = 37 \text{ degrees } 30 \text{ minutes.}$$

In the triangle OAD,

$$\frac{2-R}{R} = \tan 37 \text{ degrees } 30 \text{ minutes} = 0.76733$$

$$2 - R = 0.76733\,R \qquad R\,(1 + 0.76733) = 2$$

$$R = \frac{2}{1.76733} = 1.13165 \text{ inch}$$

$$2R = 2 \times 1.13165 = 2.2633 \text{ inches.}$$

* * *

NOTICE TO CORRESPONDENTS

All correspondents to the How and Why Department should give their full name and address. This information is not for publication, unless the correspondent wishes his name used. Communications without name and address obviously cannot be answered by mail, and questions submitted anonymously are not published.

NEW MACHINERY AND TOOLS

THE COMPLETE MONTHLY RECORD OF NEW AMERICAN METAL-WORKING MACHINERY

Gould & Eberhardt Worm-wheel Generator. Gould & Eberhardt, Newark, N. J. 759
Bennett "Triad" Furnace. W. R. Bennett Co., Elmwood, Conn. 761
Niles-Bement-Pond Boiler Plate Drilling Machine. Niles-Bement-Pond Co., 111 Broadway, New York City. 761
"Pierle" Ball Bearing Drilling Machine. Printing Machinery Co., Cincinnati, Ohio 762
Van Norman No. 20 Duplex Milling Machine. Van Norman Machine Tool Co., Waltham Ave., Springfield, Mass. 762
Manufacturing Equipment & Engineering Co.'s Washing-up Apparatus. Manufacturing Equipment & Engineering Co., Boston, Mass. 763
Edlund Sensitive Drilling Machine. Edlund Machinery Co., Inc., Cortland, N. Y. 763
Syracuse Sander Mfg. Co.'s Centering Gage. Syracuse Sander Mfg. Co., Inc., 1234 S. State St., Syracuse, N. Y. 764
"Logan" Air-operated Chucks. Logansport Machine Co., Logansport, Ind. 764
"Tamco" Pocket Scale and Square Holder. Automatic Machine & Tool Co., Inc., 87 Frankfort St., New York City. 765
Reid Universal Angle Fixture. Reid Bros. Co., Inc., Beverly, Mass. 765
Compound Table for Defiance Drilling Machine. Defiance Machine Works, Defiance, Ohio 765
Reed "Junior" Micrometer. Reed Small Tool Works, Cherry and Vine Sts., Worcester, Mass. 766
Porter-Cable Tailstock. Porter-Cable Machine Co., 1708 N. Salina St., Syracuse, N. Y. 766
Victor Universal Woodworkers' Vise. Victor Tool Co., Waynesboro, Pa. 767
"Hack" Adjustable Reamers and Taps. American Machine Tool Engineering Works, 4854-4858 W. Kinzie St., Chicago. 767
Turret Attachment for Cincinnati Lathes. Cincinnati Lathe & Tool Co., 3207-3211 North St., Oakley, Cincinnati, Ohio. . 767
"Hack" Universal Relieving Machine. American Machine Tool Engineering Works, 4854-4858 W. Kinzie St., Chicago, Ill. 768
Anderson Air-driven Scraper. Anderson Bros. Mfg. Co., 117 Morgan St., Rockford, Ill. 769
Cincinnati Planer Leveling Block. Cincinnati Planer Co., Cincinnati, Ohio 770
Hart Universal Plate Caster. Hart Roller Bearing Co., 510 Main St., East Orange, N. J. 771
Cornell Dial Test Indicator. Cornell Tool Co., Detroit, Mich. 771
Self-heated Soldering Iron. Self-heated Solder Iron Co., 420 E. 6th St., New York City 772
Kinite Tool Steel. Kinite Co., Milwaukee, Wis. 772
Ajax Upsetting Forging Machine. Ajax Mfg. Co., Cleveland, Ohio 772
Jones-Motrola Hand Tachometer. Jones-Motrola, Inc., 29-33 W. 35th St., New York City 773
Marvin & Casler Drill Chuck. Marvin & Casler Co., Canastota, N. Y. 773
Seneca Falls Quick-change Lathe. Seneca Falls Mfg. Co., Inc., 381 Fall St., Seneca Falls, N. Y. 773
Pressed Metal Machinery Co.'s "Spinhammer." Pressed Metal Machinery Co., 15 S. Clinton St., Chicago, Ill. 774
Davenport Plain Milling Machine. Davenport Mfg. Co., Meadville, Pa. 775
Borden "Beaver Junior" Pipe Threader. Borden Co., Warren, Ohio 775
Richards Drilling Machine. Richards Machine Co., 3417-3419 Vliet St., Milwaukee, Wis. 775
Bilton Split Milling Cutters. Bilton Machine Tool Co., Bridgeport, Conn. 776
Modern Expansion Sizing Tap. Modern Tool & Machine Works, Inc., 344-350 Mulberry St., Newark, N. J. 776
Fisher-Smith Ball Test Arbor. Fisher-Smith Co., Dayton, Ohio 776

GOULD & EBERHARDT WORM-WHEEL GENERATOR

This worm-wheel generator is so designed that it may be equipped with a special form of hob which is fed tangentially into the work, an increase in production being effected in certain cases by the adoption of this method of machining. If so desired, a hob of standard design may be used, which is fed radially into the work; or the machine may be equipped with a fly cutter, the latter being a useful method of cutting special worm-wheels, as it avoids the making of a hob.

To meet the demand for machines used to generate worm-wheels, which are finding a steadily increasing application in the construction of motor trucks, tractors, elevators, and other classes of machinery and equipment, Gould & Eberhardt, Newark, N. J., have placed on the market an automatic worm-wheel generating machine, which is here illustrated and described. This machine is so designed that provision is made for employing a special form of hob having a tapered section at one end, which starts cutting the teeth, and a cylindrical portion which completes the operation. In using a hob of this type, the tool is fed tangentially into the work, instead of being fed in radially, according to the usual practice where a straight hob is employed. A little thought will make it apparent that by feeding the tapered section of the hob into the work in a tangential direction, provision is made for roughing out the teeth, after which the cylindrical portion of the hob, comes into action, and finishes the teeth to the required pitch and depth. In some plants where this method of generating worm-wheels is employed, it has been found that greater production can be attained than where straight hobs are used. This method is now being advantageously employed in several factories.

In addition to the application of these specially formed hobs, this new Gould & Eberhardt worm-wheel generator can be used with straight hobs which are fed radially into the worm-wheel, or with a fly tool, which is used for cutting the worm-wheel teeth. The latter method has been found especially useful when carrying on a series of experiments where it would be costly to make special hobs for generating the teeth of each different wheel.

The success of the worm and worm-wheel drives depends largely upon the accuracy and smoothness with which the worms

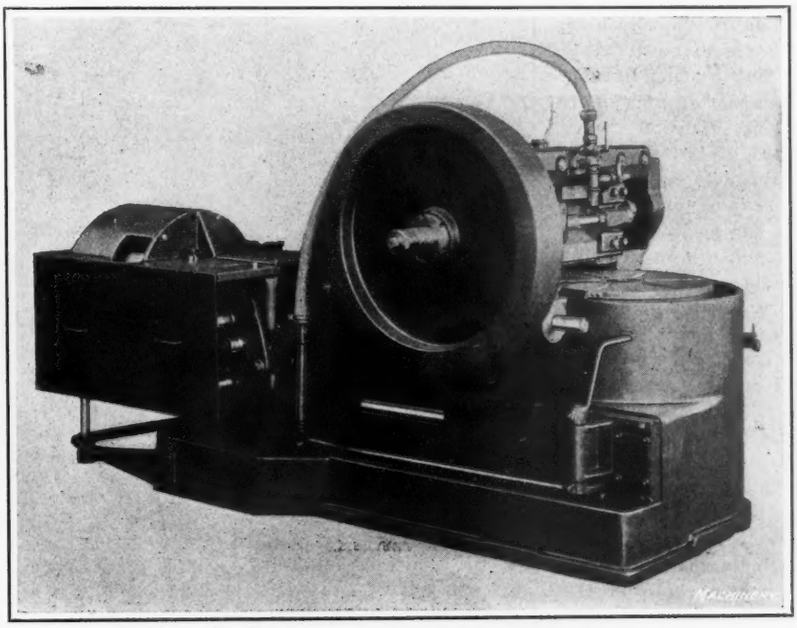


Fig. 1. Worm-wheel Generator built by Gould & Eberhardt

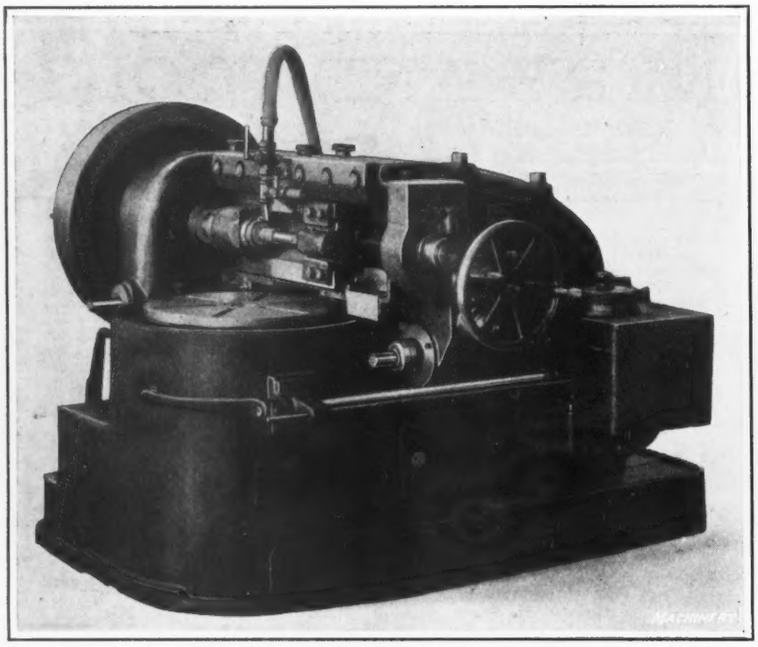


Fig. 2. Opposite Side of Worm-wheel Generator shown in Fig. 1

and worm-wheels are cut. A machine to cut worm-wheels of the required quality must be unusually substantial, with the least number of parts to eliminate torsional strains and to obtain the greatest amount of production from the hobs without their requiring grinding. Worm-wheel hobs, by nature of their design, cannot be ground back as far as ordinary hobs, with the result that it is highly important that the machines in which the hobs are used be of such substantial proportions that the hobs will cut the greatest number of worm-wheels without becoming dull. A prominent user of Gould & Eberhardt machines has made the statement that they have been able to obtain more worm-wheels per hob from that machine than from any other machine that they know of on the market. The cutter-spindle drive in this machine is through a powerful worm and worm-wheel, with a large flywheel mounted directly on the end of the cutter-spindle. It is also important that the work-table be of substantial design and powerfully driven, so that it will be rigid under heavy strains. To insure this rigidity, the table is mounted in a permanent bearing in the base, while the cutter or hob carriage is mounted on a horizontal adjustable stanchion. This permits the work-table to be arranged with a long cylindrical hub bearing in addition to a conical and flat bearing and an indexing worm-wheel of large diameter, which could not be incorporated, if the work-table were mounted on an adjustable carriage. It is essential that the work-table, or faceplate, be of convenient height for loading and unloading, and consideration has been given to this condition in the design of the machine.

All running parts are readily accessible, and all necessary operating levers are conveniently located at the front of the machine, giving the operator full and instant control. The machine is driven with a single pulley, and an efficient high-speed clutch is incorporated so that the machine may be started or stopped instantly. This is operated by a lever at the front of the machine. There are six changes of cutter speeds, ranging from 58 to 183 revolutions per minute, making it possible to run various diameter hobs at the proper speed for the material being cut. It is essential in a machine of this type to have a differential mechanism to enable the operator to take a second cut through a worm-wheel when using a tapered hob or fly tool without losing the lead. It is also an advantage, as it permits changing the feed without changing the lead gears. When using a straight hob, with automatic in-feed, the differential is not required, and convenient means are provided for locking it. A portable cutter-arbor is furnished. The cutter carriage has automatic tangential feed in one direction, and power return. An automatic stopping device is also provided, equipped with a graduated dial by means of which the operator is able to set the stopping mechanism so that it will stop the cutter carriage at any predetermined point. The stanchion is provided with automatic in-feed and power return. When feeding automatically into the revolving worm-wheel blank, an automatic stop is provided, which is equipped with a graduated dial so that the operator can set the mechanism to stop at any predetermined point. When tangential feed is being used, the stanchion is adjusted to the proper depth of tooth and then securely bolted to the base of the machine, by means of four bolts. In adjusting the stanchion by hand, a dial, graduated in thousandths, is furnished, in addition to a scale and vernier, to set the hob and worm-wheel blank at the required center distance. An efficient centrifugal pump is regularly furnished with each machine to allow the use of a coolant, when cutting steel or bronze. It is neatly attached to one side of the machine, being driven by gears. It may be conveniently disconnected by means of a clutch.

The capacity of this machine is for cutting worm-wheels up to 18 inches in diameter, with from 10 to 100 teeth, including prime numbers, and also from 100 to 120 teeth, with the exception of prime numbers. This work is accomplished with hobs having from a single up to a quintuple thread. The principal dimensions are as follows: Maximum diameter of hob, 5½ inches; maximum length of hob, 8 inches; tangential travel of cutter-slide, 10 inches; maximum center distance from cutter to work-spindle, 13¼ inches; minimum center distance from cutter to work-spindle, 3 inches; fixed distance from top of faceplate to center of cutter-arbor, 7 inches; diameter of cutter-arbor, 1¼ inch.

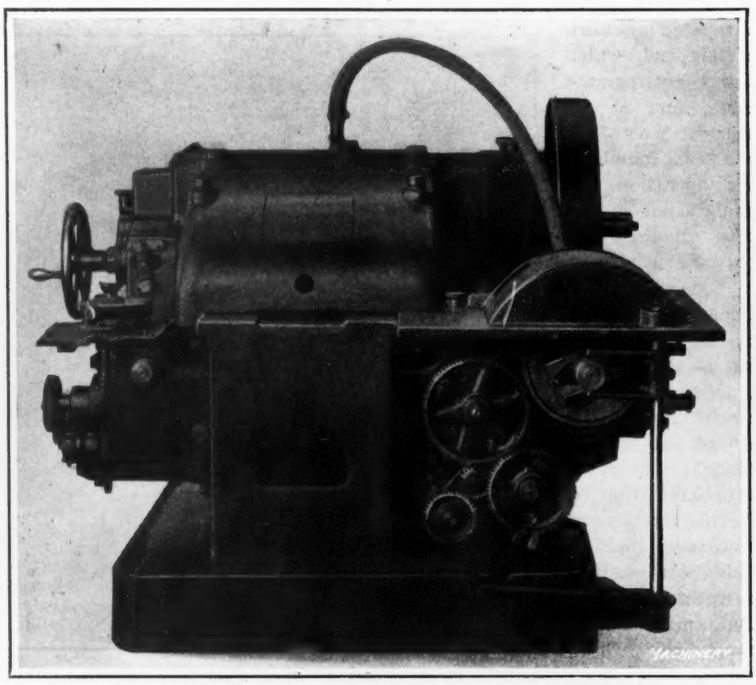
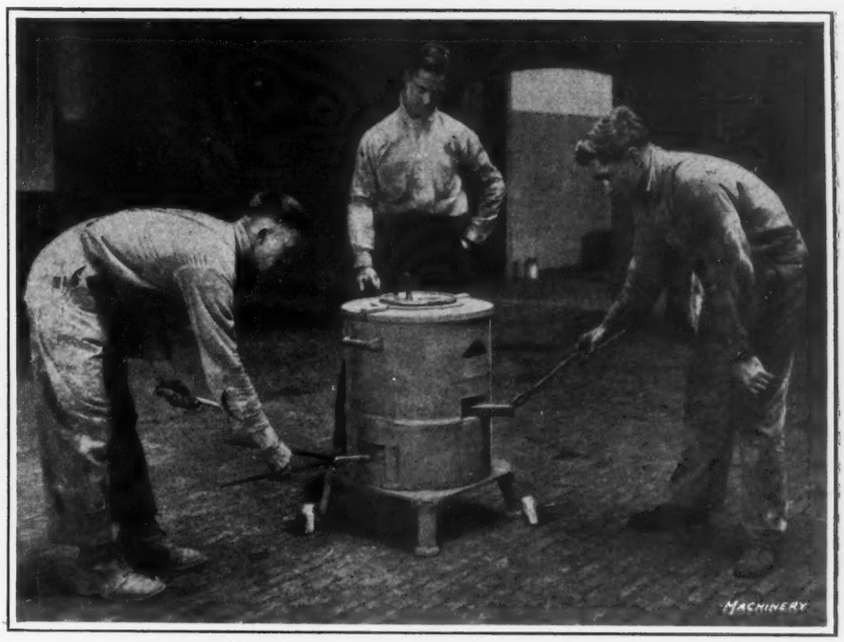


Fig. 3. Rear View of Gould & Eberhardt Worm-wheel Generator

BENNETT "TRIAD" FURNACE

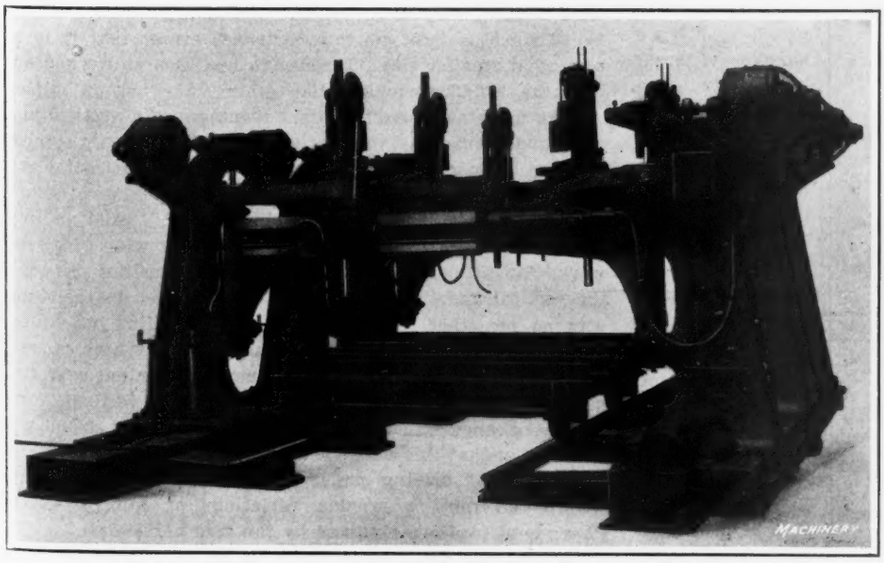
The name "Triad" has been given to a furnace recently placed on the market by the W. R. Bennett Co., Elmwood, Conn., owing to the fact that provision is made for subjecting the work to temperatures of three different intensities. With this furnace, the work may be heated to a forging temperature, or it may be brought to temperatures suitable for hardening. An important feature of the equipment is that either of these results may be obtained without in any way interfering with the use of the furnace for the obtainment of any one of the other results. This point is rather well brought out in the accompanying illustration, where three men are shown engaged in using the three different sections of the furnace. At the bottom, there is an opening into which the work may be introduced to expose it to the full temperature of the gas or oil flame, this being the compartment of the furnace that is employed for raising the work to a forging temperature. The second, or middle, compartment is a sort of muffle furnace, in which the temperature of the work may be raised to the required degree for hardening; and at the top of the furnace there is a lead bath in which the work may also be heated for hardening. By way of conclusion, attention is called to the fact that a furnace of this type enables a variety of different classes of work to be handled without involving an investment in separate equipments for the various purposes, and without requiring as much floor space as would be necessary for the setting up of a separate heating apparatus for the performance of forging and hardening operations.



"Triad" Furnace made by the W. R. Bennett Co.

NILES-BEMENT-POND BOILER PLATE DRILLING MACHINE

To provide for drilling all of the holes which are required in boiler plates of considerable length, the Bement Miles Works of the Niles-Bement-Pond Co., 111 Broadway, New York City, have recently designed and placed on the market the six-spindle drilling machine which forms the subject of the following description. It will be apparent that this equipment comprises two sets of three radial drilling machines which are mounted on beds running parallel to each other. Each drilling machine is equipped with an individual motor drive and provided with longitudinal adjustment along the bed. When so desired, any or all of the machines may be locked in any desired position, or positions, on the bed. Running between the two rows of drilling machines, there is a track on which two trucks are free to travel, in order to provide means of supporting long boiler plates and of carrying them backward and forward under the drilling spindles. This is a very convenient arrangement, because not only are the machines adjustable on the bedplates, but the radial arms afford a very convenient way of reaching over a considerable area on the work; and where the space to be covered is too great to come within reach of the arms, this difficulty can easily be overcome by moving the truck on which the work is carried. The illustration shows only one truck, but in practice it is usual to employ two, in order that long boiler plates may be held without tendency for deflection of the work to cause trouble. The trucks are 10 feet 6 inches square, and they are built of structural steel, with capacity for carrying a load of 20 tons. The wheel journals are provided with roller bearings so that the trucks move easily.



Six-spindle Boiler Plate Drilling Machine built by the Bement-Miles Works of the Niles-Bement-Pond Co.

It will be evident from the illustration that the radial arm of each of the drilling machine units is located at a fixed height on the column. The arms are provided with ball thrust bearings in both the top and bottom trunnions, so that they swing easily, and a pneumatic clamp is provided on each arm for rigidly holding it in the desired position. These pneumatic clamps are furnished with valves which are conveniently located for the operator. Each machine is independently driven by a 10-horsepower variable-speed motor, covering a range of from 400 to 1600 revolutions per minute, and is adapted for operation on a 220-volt direct-current cir-

cuit. Each motor is furnished with a non-reversing drum controller. Speed gears placed in the drive provide for obtaining spindle speeds covering a range of from 28 to 343 revolutions per minute. The spindles are counterbalanced and equipped with an automatic trip; and the back-gears are located directly on the drill heads. An 18-inch vertical-spindle traverse is provided, and there are six changes of power feed. The spindles are also provided with hand adjustment. The maximum distance between the end of the spindles and top of the bed is 55½ inches, and the minimum distance, 37½ inches; the maximum distance from the end of the spindles to the floor is 69 inches, while the minimum distance is 51 inches. A maximum traverse of 77 inches is provided for the saddles on the radial arms. Each set of three radial drilling machines is mounted on a bed 21 feet 3 inches long by 42 inches wide, which permits of obtaining a maximum distance of 17 feet 9 inches between the outside spindle centers when the radial arms are located at right angles to the bed. Projections extending out from the bed of the machine afford ties to which the truck rails are bolted. Provision is made for traversing each radial drilling machine along its bed in either direction by means of screws which are driven by a 7½-horsepower variable-speed direct-current motor. The design has been worked out in such a way that the columns may be traversed independently or in unison. A tank and pump for the circulation of cutting solution is provided with the machine, the pump being driven by a 3-horsepower constant-speed motor through direct current. The tank is placed beneath the floor to receive the cutting solution, as it drains from the channels provided in the concrete foundation.

"PIERLE" BALL BEARING DRILLING MACHINE

The accompanying illustrations show a ball bearing sensitive drilling machine which is being built in single- and multiple-spindle types, with and without power feed and with two types of motor drive, by the Printing Machinery Co., Cincinnati, Ohio. The machine is equipped throughout with double-row ball bearings mounted in the different members so as to be dirtproof and grease-tight and thus insure a long life to the machine. Four changes of speed of the spindle are obtainable by means of a belt-shifting arrangement carried on the top bracket. The shift is intermittent and operated through a cam-drum, the belt being shifted off the step on one cone and then onto the corresponding step on the other. This permits of using a tight belt. Further tension is put on the belt by a ball bearing idler pulley held against the belt by a spring plunger. When shifting, however, the tension on the belt is first removed by the cam on the top bracket holding out the idler, and after the shift has been accomplished, the idler is again thrown into engagement. The cones are finished inside and out, insuring perfect balance, and they are mounted on steel with an inserted wide-faced rack, the spindle being mounted in the sleeve with two radial bearings and one thrust bearing. The rack pinion is also made of steel and hardened. The drive in the gear-box at the rear of the base is through spiral gears which are made of chrome-nickel steel and hardened; these gears are mounted on base bearings, and they run in oil. The drive shaft from their box to the top bracket is enclosed in a tubular brace which stiffens the machine considerably and also offers protection from the revolving shaft. The loose pulley is also mounted on double-row ball bearings. The whole design is exceedingly simple. There is nothing to get out of order, and this, with the method of mounting the bearings to protect them against damage from dirt and grit, should insure a long life to the machine.

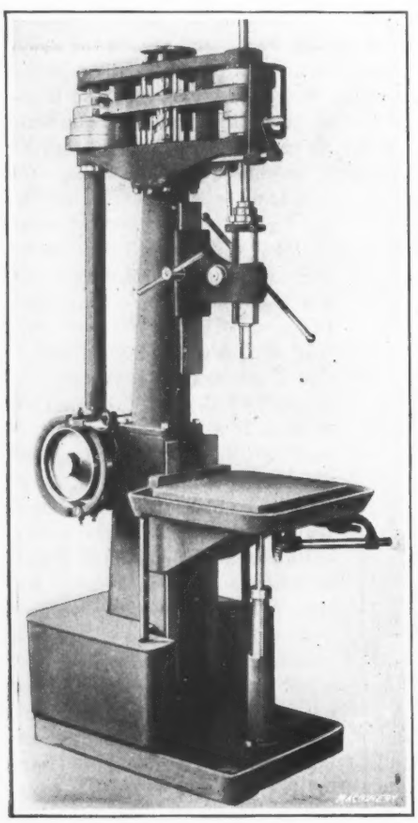


Fig. 1. "Pierle" Ball Bearing Drilling Machine built by the Printing Machinery Co.

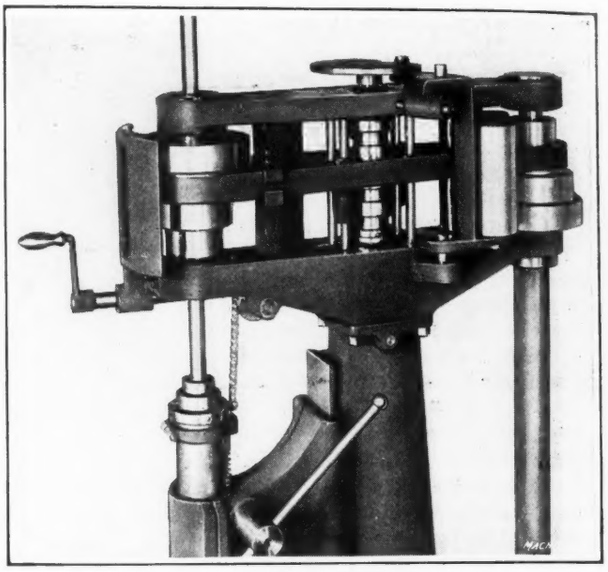
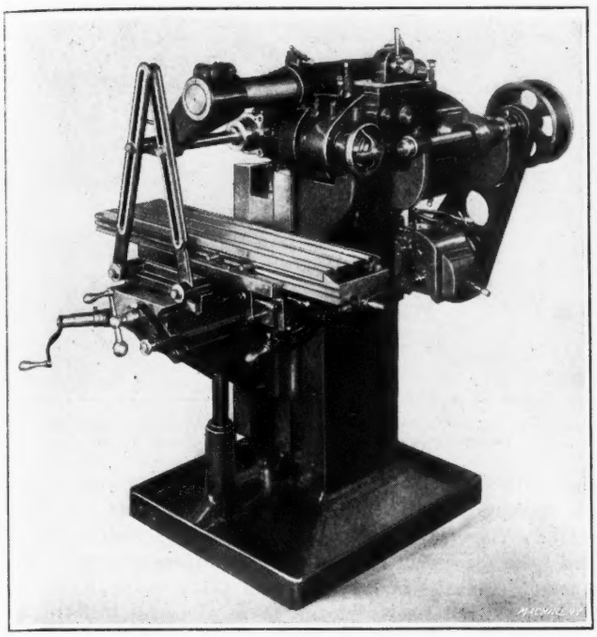


Fig. 2. View of Driving Arrangement of Drilling Machine

VAN NORMAN NO. 20 DUPLEX MILLING MACHINE

The Van Norman Machine Tool Co., Waltham Ave., Springfield, Mass., is now building a No. 20 duplex milling machine with single pulley drive, which is of similar design to the No. 3 machine built by this company, except that it is of somewhat smaller size. The design has been so worked out that the No. 20 machine, like other Van Norman duplex milling machines, combines the advantages of a vertical and a horizontal machine, in addition to which the cutter-spindle can also be operated at all angles between the horizontal and vertical positions. The adjustable feature of the cutter-head and ram, which are quickly set and locked in any position, enables this machine to handle a wide range of work. Adjustment of the spindle to any position between the vertical and the horizontal is accomplished in the same way as on other Van Norman duplex milling machines, namely, through the use of an adjustable cutter-head mounted on a ram or frame that can be moved in or out over the milling machine table in order to adapt it for vertical, horizontal, or angular cutting. It will be apparent from the illustration that this new No. 20 machine is equipped with a constant-speed driving pulley and change-gear mechanism within the ram to provide variations of spindle speed. Changes of feed are obtained by the gear-box shown.

The principal dimensions of the No. 20 Van Norman duplex milling machine are as follows: Movement of main head



No. 20 Duplex Milling Machine built by the Van Norman Machine Tool Co.

frame or ram in and out over the column, 11½ inches; length of spindle, 15¾ inches; taper of hole in spindle, No. 13 B. & S.; number of available speed changes, 12; range of spindle speeds, 21 to 350 revolutions per minute; diameter of driving pulley, 10½ inches; width of driving pulley, 4 inches; speed of driving pulley, 385 revolutions per minute; number of available feed changes, 16; range of available feeds, ⅜ inch to 12 inches per minute; working surface of table, 42 by 9¾ inches; maximum longitudinal movement of table, 28 inches; length of saddle, 24½ inches; maximum automatic transverse feed, 12 inches; maximum vertical movement on knee, 18 inches; diameter of over-arm, 4 inches; size of countershaft pulleys, 10 inches diameter by 4 inches face width; recommended speed of countershaft, 335 revolutions per minute; and net weight of machine, about 3800 pounds.

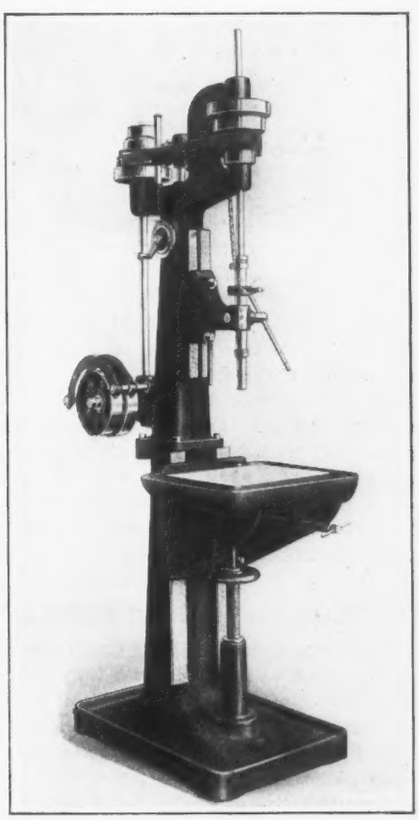
MANUFACTURING EQUIPMENT & ENGINEERING CO.'S WASHING-UP APPARATUS

A new type of washing-up apparatus designed to provide facilities for a considerable number of persons at the same time, has recently been put on the market by the Manufacturing Equipment & Engineering Co., Boston, Mass. Various types of wash-bowls built in batteries have been on the market for some years; one type, which has filled a long-felt want, is that having the bowls arranged in batteries with a common water supply and common waste, manufactured by this company. Whereas this earlier type was designed with common water supply and common waste, the bowls now offered have these features and also a common vent. Every bowl is trapped and vented. The bowls are furnished in double or single batteries as the user may desire. If used in double batteries, that is, a row of bowls on each side of the middle line of the structure, the two opposing bowls are trapped into an upright pipe which, in turn, connects vertically with the common vent that is either a 3-inch or a 2-inch pipe forming the top of the apparatus and supported by the hollow cast-iron pipe casting which extends from the top to the bottom flanged foot of the apparatus. This vent pipe serves to support the balance of the structure.

There is a hollow upright casting for each two bowls in a double battery; these upright castings are made integral with the two traps, one on each side, and extend below the waste pipe. The bottom pipe in the apparatus is only used when needed for support; at other times it connects the vent pipe at the top and the waste pipe at the bottom, not extending to the floor. Every bowl in this apparatus is trapped and vented through the upright to the common vent pipe. The most approved type of plumbing construction is used throughout, including recessed joints. This apparatus is designed to be variously furnished. It may have hot and cold or one temperature of water; and it may be arranged in double or single rows or batteries, with plain cast iron, galvanized iron, or vitrified porcelain enameled bowls. This bowl structure supplies a compact grouped bowl fixture of a highly sanitary type; the number of connections is reduced to a minimum; and the apparatus is shipped almost completely set up, so that the expense of erection is very small.

EDLUND SENSITIVE DRILLING MACHINE

One of the recent products of the Edlund Machinery Co., Inc., Cortland, N. Y., is a No. 2B sensitive drilling machine which is shown in the accompanying illustration. Machines of this type are built in combinations of from one to six spindles, and they are equipped with ball bearings to provide for operation at high speed. All changes of speed may be made from the operating position, without requiring the machine to be stopped. Power is transmitted from the driving pulley through two bevel gears and a vertical shaft at the rear of the machine to a four-step cone pulley, from which an open endless belt drives the cone pulley at the front of the machine. The spindle is made of high carbon steel, and is provided with two driving splines fitted into grooves on opposite sides of the spindle. Both the spindle and cone pulleys are carefully balanced, which is an important factor in adding to the sensitiveness of the machine and its freedom from vibration when running at high speeds. A small reservoir is provided at the top of the spindle sleeve, which contains a sufficient volume of oil to lubricate the bearings without the need of frequent attention. The spindle sleeve is made of gray cast iron, and is accurately reamed on the inside and ground on the outside. The stop-collar is provided with an adjustable depth screw. The sliding arm has a bearing 9 inches in length upon the surface of the column, and it is fastened to the column with a bolt at the upper end, which is so adjusted that raising and lowering of the arm is accomplished by simply unlocking the clamping lever on the lower end of the arm, without requiring the use of a wrench. Four speed changes are provided, the belt-shifting device being operated by a rack and pinion, controlled by means of a handle at the left side of the machine, which is located within easy reach of the operating position. To change the speed, the operator simply shifts the handle one-fourth turn. An adjustable idler pulley provides for taking up any slack that may exist in the belt.

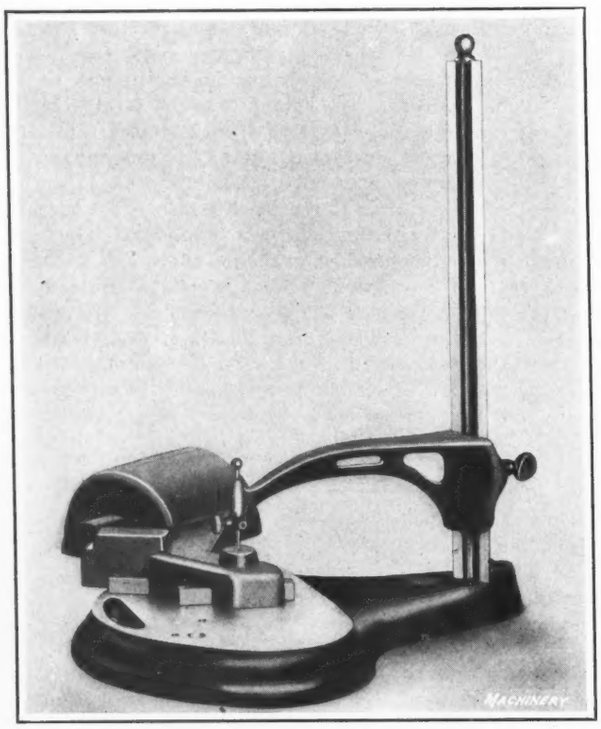


Sensitive Drilling Machine built by the Edlund Machinery Co., Inc.

SYRACUSE SANDER MFG. CO.'S CENTERING GAGE

For use in transferring centers on patterns, the Syracuse Sander Mfg. Co., Inc., 1234 S. State St., Syracuse, N. Y., has developed a precision centering gage, which forms the subject of the following description. It is claimed that this instrument is the means of saving a great deal of time in accomplishing the particular class of work for which it is intended. In using this gage, the fine point of the centering scriber is pressed into the center to be transferred. The pattern is then placed with the center point in the hole in the base of the gage, and the scriber in the arm is then lowered to engage the work, thus transferring the center with absolute accuracy, and with the consumption of an inappreciable amount of time.

It will be evident from the illustration that the scriber which is pressed into the center laid out on one side of the work is located in accurate alignment with the scriber carried by the arm of the gage. As a result, lowering the arm to bring the scriber carried by it into contact with the work,



Gage made by Syracuse Sander Mfg. Co. for Use in transferring Centers on Patterns

provides a convenient method of laying out center points, lines, etc., on one side of either a plain or an irregular shaped piece of work in accurate alignment with points or lines on the opposite side. By placing the scriber horizontally in the arm, this tool may also be used as a surface gage. The principal dimensions are as follows: Height overall, 16 inches; vertical capacity for work up to 12 inches; distance from center hole of base to perpendicular post, 6 inches; number of center points furnished, 6; weight of tool, 7 pounds.

"LOGAN" AIR-OPERATED CHUCKS

The Logansport Machine Co., Logansport, Ind., has recently added to its products a line of air-operated two- and three-jaw combination and universal chucks, which are used in connection with a double-acting air cylinder of new design. Fig. 1 shows one of these "Logan" air-operated three-jaw combination chucks connected with a double-acting air cylinder, the entire apparatus being mounted on a turret lathe. A better idea of the chuck construction will be obtained from Fig. 2, which shows a sectional view of the three-jaw

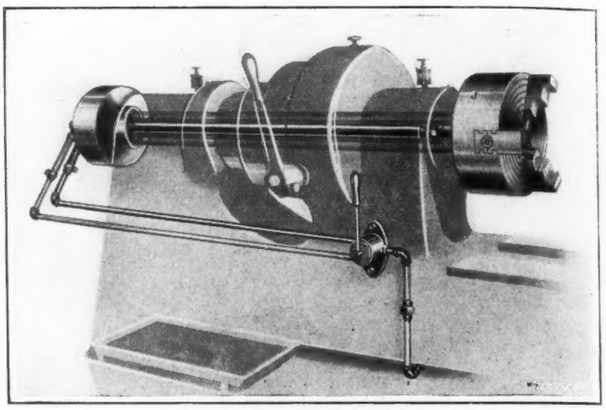


Fig. 1. "Logan" Air-operated Three-jaw Combination Chuck and Double-acting Air Cylinder mounted on Turret Lathe

combination chuck which has been designed in such a way that advantage is taken of maximum power and minimum weight. The body of the chuck is a single casting, which eliminates the use of bolts, screws, etc., thereby producing a chuck of unusual strength, and eliminating one of the causes of chatter. For operating the jaws, a special heat-treated lever is used, to which there are pivoted hardened and ground blocks that engage similarly finished ways in both the draw-tube and chuck jaw slide. The jaws are operated under a leverage ratio of 3 to 1; which insures ample force being applied to hold the work. It is claimed that these chucks are made as nearly dustproof as possible. The taper on the draw-tube and the lower end of the chuck jaw slide move together. As the draw-tube is pulled back by the air cylinder, it advances the chuck jaw slide so that an equal distance between the chuck jaw slide and the draw-tube is always maintained. In order to reduce friction and wear, a piece of felt is inserted between the draw-tube and chuck jaw slide, making an absolutely dustproof joint for all positions of the chuck jaw slide, and completely eliminating the trouble caused from chips or dirt finding their way into the bearing mechanism. Provision is made in the draw-tube for inserting a bushing, which is used to support the boring-bars. These chucks are made with either two or three jaws in both combination and universal types, and they are made in sizes having sufficient capacity to hold work up to 7, 9, 12, 15, or 18 inches outside diameter.

In Fig. 3, there is shown a cross-sectional view of the "Logan" double-acting air cylinder, which has been designed to combine simplicity and lightness of weight with assur-

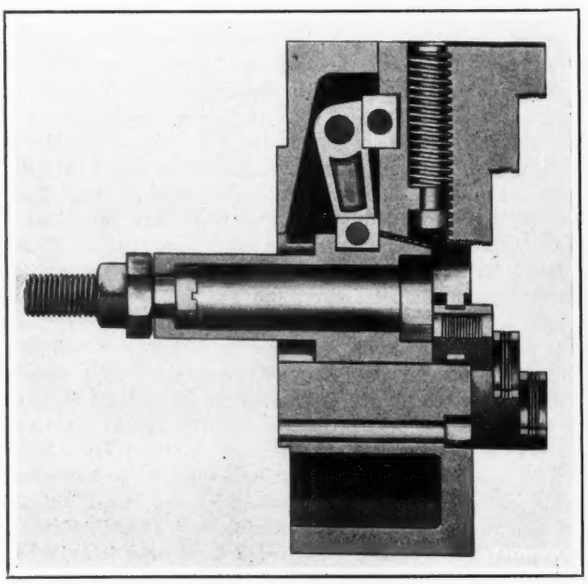


Fig. 2. Sectional View of "Logan" Air-operated Three-jaw Combination Chuck

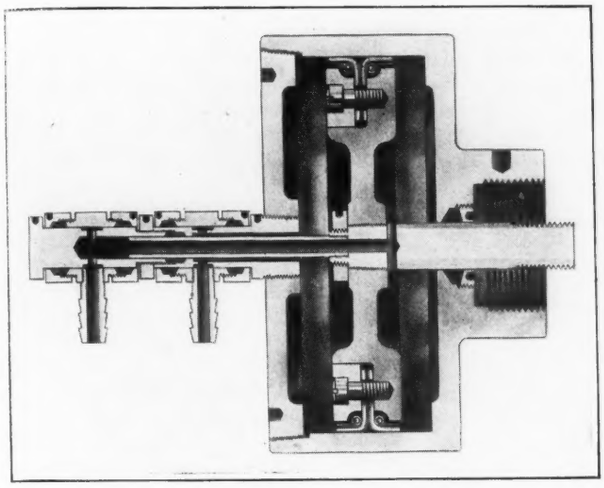
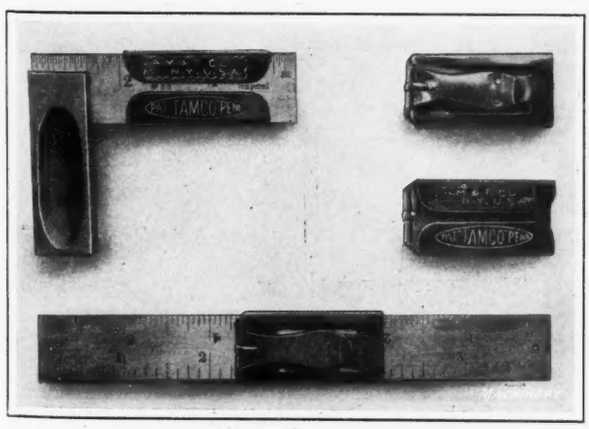


Fig. 3. "Logan" Double-acting Air Cylinder

ance of maximum service. Liberally proportioned air channels are furnished, which assure rapid operation, and the packings have been made accessible for quick adjustment or repacking. Attention is called to the fact that there are no projecting parts which are likely to injure the operator, and that the design of the piston provides for the use of the Johns-Manville air cylinder packing cup and expander ring. The cold-rolled steel expander ring holds the packing cup against the bore of the cylinder, and gives a pressure contacting surface ½ inch wide all the way around the bore of the cylinder. When air is admitted to the cylinder, it enters through the channel between the outside of the piston and the inside of the expander ring, thereby increasing the pressure of the packing cup against the cylinder bore, and giving an absolutely tight joint, which assures the full air pressure being applied to the piston at all times. The air shaft of the cylinder has been designed so that it can be repacked or adjusted without reference to the air hose connection. These double-acting cylinders are regularly made in 3-, 4½-, 6-, 8-, 10-, 12-, 14-, and 16-inch bores. The "Logan" air valve for operating the cylinder is provided with a semi-steel body having a hand-lapped bronze tapered plug. It is designed for direct piping to the cylinder without the use of elbows or other fittings. All internal parts are readily accessible for cleaning and oiling by simply unscrewing a cover, which permits the removal of all parts without disconnecting the valve body. The Frank G. Payson Co., 9 S. Clinton St., Chicago, Ill., is the selling agent.

"TAMCO" POCKET SCALE AND SQUARE HOLDER

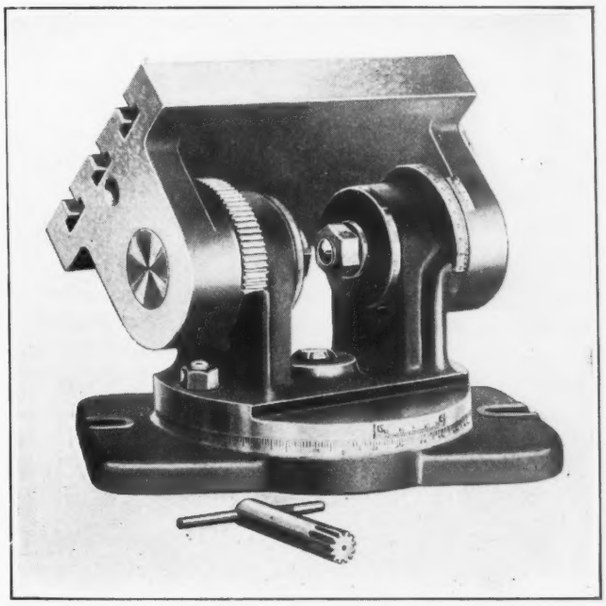
The "Tamco" pocket scale and square holder is made by the Automatic Machine & Tool Co., Inc., 87 Frankfort St., New York City, for the use of toolmakers and other mechanics who use pocket scales and squares. This device serves two purposes: First, it acts as a holder for the tools and enables them to be clipped to an apron or overalls so that they are always ready for immediate use. The tool secured in the holder is slipped through the top. Two spring clips apply sufficient pressure to prevent the tool from slipping out of the holder and being lost, as is commonly the case when tools are carried loose in a pocket. Second, this holder can be used as a scale reader, as it slides freely along the scale or square, and has a straight edge which is always parallel to the graduations. The holder is made from spring steel, and is composed of a single piece of metal, so that there are no parts which are likely to be broken. A nickel plated finish applied to the holder gives it a good appearance.



Pocket Scale and Square Holder made by the Automatic Machine & Tool Co., Inc.

REID UNIVERSAL ANGLE FIXTURE

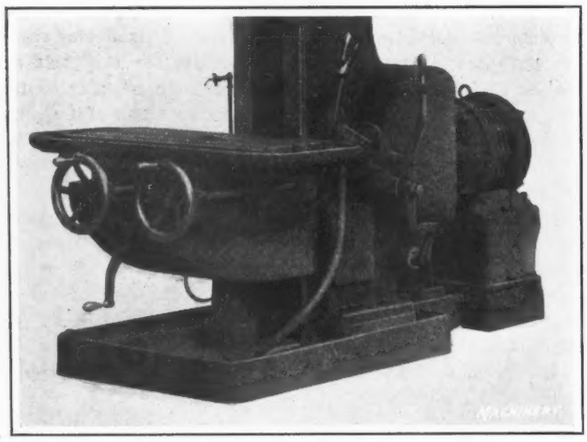
Reid Bros. Co., Inc., Beverly, Mass., is now manufacturing a universal angle fixture which is shown in the illustration accompanying the following description. This fixture is made to swivel through 360 degrees in a horizontal plane, and through 180 degrees in a vertical plane, which facilitates the setting of compound angles. Readings in both planes are made by a double vernier, which permits setting to within 1/12 of 1 degree (5 minutes) on either side of the center position. For making finer adjustments, a sine-bar attachment is provided, and adjustments in the vertical plane are made by a gear and pinion wrench of a sufficiently high ratio to assure obtaining accurate settings. The table is carefully fitted to the swivel head, and bored with great accuracy. Four large clamping surfaces afford a permanent setting in any position. The swivel head is locked to the base by means of two bolts, which prevents any possible lifting, and the design has been worked out in a way which eliminates overhang, and prevents the lodging of chips and dirt, and other undesirable conditions of operation. This universal angle fixture is made in three sizes, namely, 6 by 9, 8 by 12, and 12 by 18 inches.



Universal Angle Fixture made by the Reid Bros. Co., Inc.

COMPOUND TABLE FOR DEFIANCE DRILLING MACHINE

In the February, 1918, number of MACHINERY a description was published of the No. 3 24-inch heavy-duty drilling machine which had just been placed on the market at that time by the Defiance Machine Works, Defiance, Ohio. In the accompanying illustration is shown a compound table for use

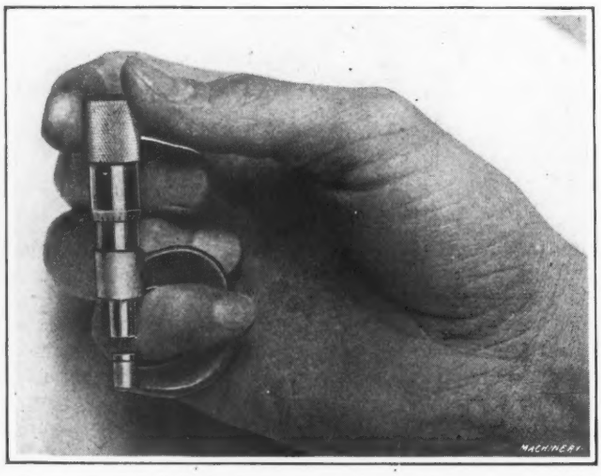


Compound Table for Drilling Machine built by the Defiance Machine Works

on the machine. It will be apparent that this is not an attachment added to the regular plain table, but that it consists of a special box type of bracket supporting the intermediate slide and the table which has a working surface 17½ by 35 inches in size. This table has a longitudinal adjustment of 18 inches, and a cross adjustment of 9 inches. It is furnished with three T-slots running lengthwise, and a liberally proportioned oil-groove. The same form of elevating screw is employed as in the case of the plain table; and when the compound table is furnished, it is necessary to use a higher column in order to afford the same maximum distance from the nose of the spindle to the table.

REED "JUNIOR" MICROMETER

A ½-inch micrometer caliper known as the Reed "Junior" has recently been added to the line of the Reed Small Tool Works, Cherry and Vine Sts., Worcester, Mass. The claim is made that this tool is of exceptionally sturdy construc-



Reed "Junior" ½-inch Micrometer made by the Reed Small Tool Works

tion, so that it will stand up under severe conditions of service. It is equipped with a solid anvil and two-part thimble, instantaneous adjustment being afforded. The diameter of the spindle, barrel, and thimble is the same as that of the 1-inch to 6-inch micrometers of this company's manufacture, but these parts have been reduced in length to adapt them for assembly in the ½-inch tool. The Reed "Junior" is small enough to be conveniently slipped into the vest pocket, and still large enough to be easily operated with one hand, the deep throat of the tool allowing sufficient space through which to pass the little finger of the hand which grasps the micrometer. A natural thumb and finger grip is furnished on the concave web of the drop-forged steel frame, this being an especially important feature when the micrometer is being used on work on which there is a lot of oil. Like other Reed micrometers, the ½-inch size is given a dull nickel finish on which the graduations stand out so that they may be easily read. Micrometers of this size are furnished in both English and metric systems and they may be provided with a lock-nut and ratchet stop if so desired.

PORTER-CABLE TAILSTOCK

The Porter-Cable Machine Co., 1708 N. Salina St., Syracuse, N. Y., has recently brought out a new tailstock and center for the Porter-Cable lathe, which will be found useful in the performance of many lathe operations. In this construction, the usual tail-spindle is omitted, and the ordinary center is replaced by a dovetail slide having a center point formed on one end. The illustration shows the means provided for moving the center in and out, and also the usual manner of clamping it in position. No portion of the center or adjacent parts projects forward toward the operator more

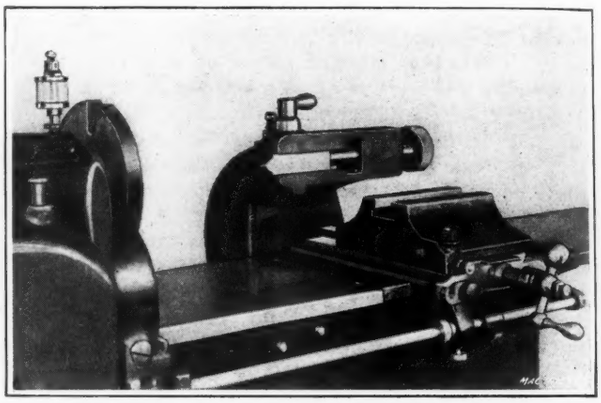


Fig. 1. Improved Type of Tailstock developed by the Porter-Cable Machine Co.

than 5/32 inch from the center point. It is plain, therefore, that when turning a part as small as 5/16 inch in diameter, it is unnecessary to draw back the cross-slide when it is desired to run the carriage and tool to the right, past the tailstock, for the purpose of measuring or filing the work.

This device is especially useful when operating a gang tool-holder, with multiple tools turning parts having several diameters, one or more of which may be smaller than the ordinary round tail-spindle, and the over-all length sufficient to preclude the use of a gang of tools if it were not possible to run past the tailstock as shown in Fig. 2. The tailstock is also found very convenient in connection with a turret toolpost, as it is unnecessary to draw back the cross-slide to provide room for swinging the tool when indexing. The center may be ground back ¾ inch before renewal is necessary, but it is recommended as a matter of economy that several centers be kept on hand ground ready for use. A special fixture for grinding is furnished with each equipment. This improved tailstock can be readily applied to

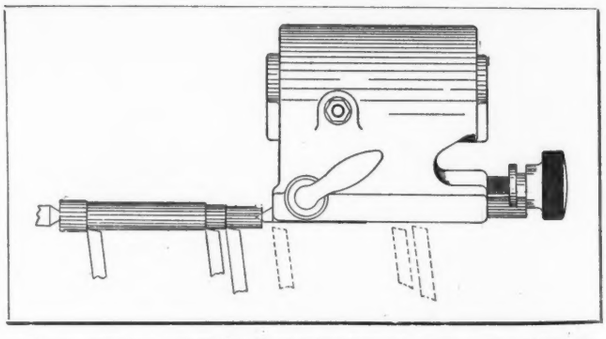
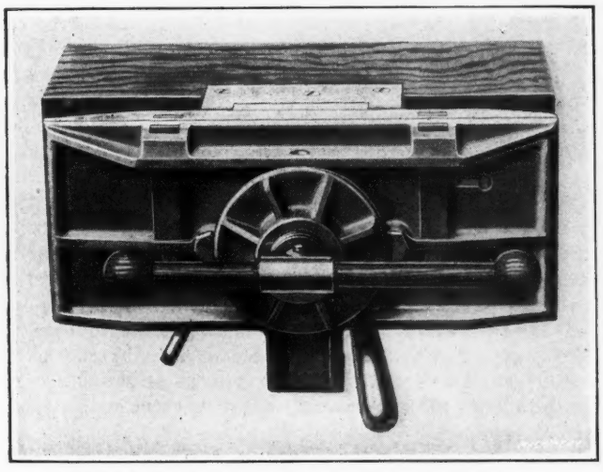


Fig. 2. Top View of Tailstock showing how advantageously a Gang of Tools can be used

Porter-Cable lathes now in use, as the grinding fixture is adjustable to conform to the alignment of the lathe on which it is to be used. A setting gage and complete information goes with each outfit.

VICTOR UNIVERSAL WOODWORKERS' VISE

One of the recent products of the Victor Tool Co., Waynesboro, Pa., is a universal woodworkers' vise, which is here illustrated and described. This vise is said to be capable of holding securely all classes of work which come within its range, and it can be easily adjusted to almost any conceivable position, very little time being required for making such adjustments. The vise can be set at any point within a 90-degree perpendicular arc; and it may also be rotated and set in any desired position around a circle in a horizontal plane. No matter how awkward the work may be, these features of setting make it possible for the vise to be located



Universal Woodworkers' Vise made by the Victor Tool Co.

in a position which enables the operator to work under advantageous conditions. Wedge shaped work will fit either end of the jaws, as they are made to swing about a pivotal center. The vise is equipped with holding dogs that are suitable for grasping thin wood for surfacing operations, and it also has a pair of suitable jaws for holding metal parts. The main jaws are furnished with "button-hole" openings to provide for the use of any shape or style of wooden pads for holding soft wood. The jaws are smoothly finished and measure 7 by 18 inches, with a maximum opening of 15 inches.

"HACK" ADJUSTABLE REAMERS AND TAPS

The "Hack" adjustable reamers, which are a recent product of the American Machine Tool Engineering Works, 4854-4858 W. Kinzie St., Chicago, Ill., provide a means of reaming

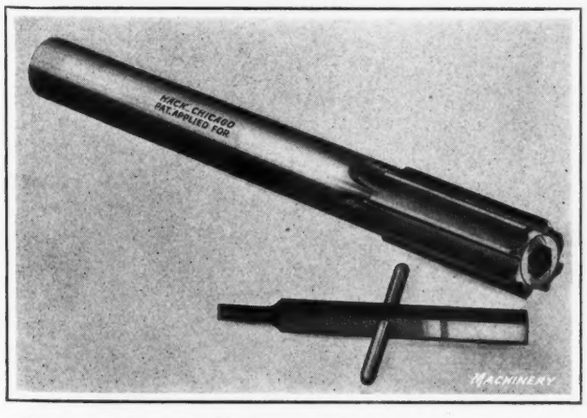


Fig. 1. "Hack" Adjustable Reamer made by the American Machine Tool Engineering Works

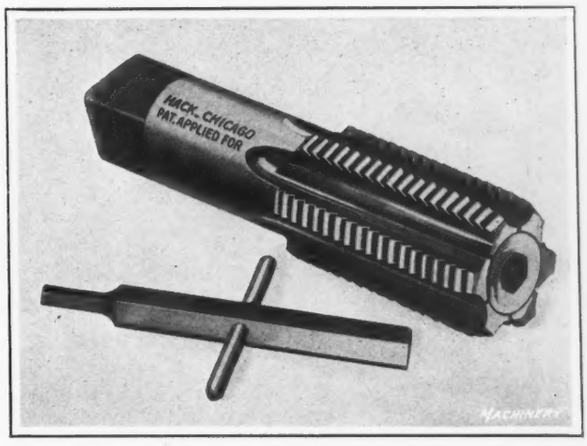


Fig. 2. "Hack" Adjustable Tap made by the American Machine Tool Engineering Works

holes to either the standard diameter, or under size or over size, with the same tool. Also, these reamers may be ground when they become dull, and then readjusted to the specified diameter. It will be apparent that the body of the tools is split in order to allow the cutting edges to be expanded or contracted as desired. In Fig. 2 there is shown an adjustable sizing tap of the same general construction, and the best idea of the way in which both of these tools are set to any specified diameter will be obtained from the partial cross-sectional view of the reamer shown in Fig. 3. Here it will be seen that there are two adjusting cones *A* and *B*, which are designed on somewhat the same general principle as safety set-screws, cone *A* being engaged by the large end of wrench *C*, while cone *B* is engaged by the small end of the same wrench. Evidently, the expansion of either a reamer or a tap of this type is accomplished by first slacking off cone *B* and then tightening cone *A*. The tapered

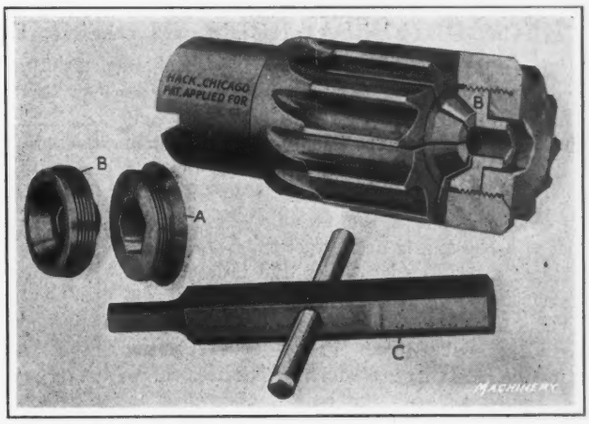
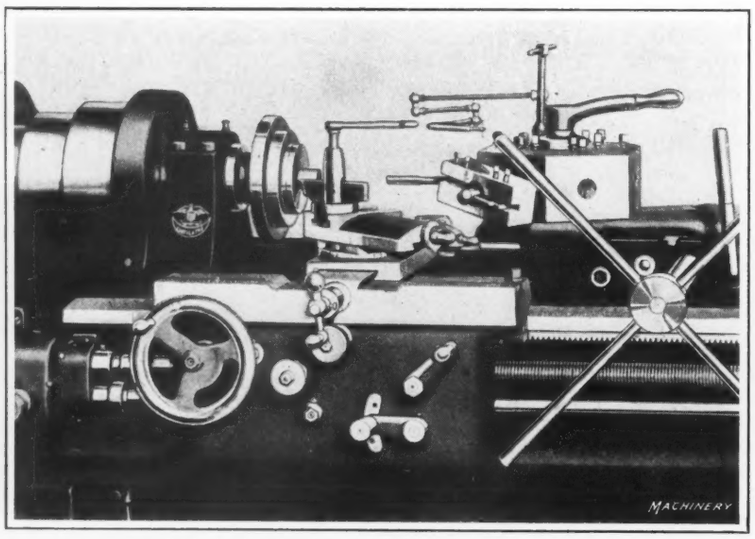


Fig. 3. Partial Sectional View of "Hack" Reamer showing Method of making Adjustment

flange on this cone engages a corresponding tapered surface on the inside of the tool, causing it to be expanded to the required diameter, as indicated by the measurement taken by a micrometer caliper. After the required size has been secured, cone *B* is again tightened so that its tapered surface engages the corresponding beveled surface on the inside of the tool. Tightening cone *B* causes the segments of the tool to be locked closely down onto the tapered flange of cone *A*, thus permanently setting the tool to the required diameter. To contract the tool to a smaller diameter, the method of procedure is the reverse of that described.

TURRET ATTACHMENT FOR CINCINNATI LATHES

For use on engine lathes of its manufacture, the Cincinnati Lathe & Tool Co., 3207-3211 North St., Oakley, Cincinnati, Ohio, has recently developed a turret attachment which



Turret Attachment for Lathes built by the Cincinnati Lathe & Tool Co.

is shown in the accompanying illustration. Other features of the lathes on which this attachment is used are the same as those of the machines of this company's manufacture which are generally known in the trade. The machine is equipped with a pan, pump, turret tool-holder, double friction back-gears and a hexagonal turret. The illustration shows the machine working on a bevel gear blank which is 5½ inches in diameter by 1¾ inches wide, having a 1⅝- by 1½-inch hub, in which a ¾-inch hole is bored. This gear blank was completely machined on both sides, including the forming of the bevel, in nine minutes. The machine was operated with a feed of 0.120 inch per revolution of the spindle, and with a cutting speed of 128 feet per minute.

"HACK" UNIVERSAL RELIEVING MACHINE

The "Hack" high-power universal relieving machine is made in 6-, 10- and 16-inch sizes by the American Machine Tool Engineering Works, 4854-4858 W. Kinzie St., Chicago, Ill. This machine is constructed with the pan and legs cast integral, the pan being located close to the floor in order to afford space for a bed of ample width and depth. The bed is designed with two distinct sets of ways; the headstock and tailstock are carried on one set, and the carriage is supported by both sets. The second set of ways serves the additional purpose of supporting the side relieving attachment. The lead-screw is located between the rear set of ways on which the carriage travels, this location permitting of an exceptionally free movement for the carriage.

The headstock includes a number of new features of design, some of which are quite radical. Attention is called to the self-contained countershaft which forms a part of the head. Power is transmitted to this relieving machine directly from the lineshaft or jack-shaft, through one forward and one reverse belt, without idlers or intermediates of any sort. The drive is carried from the pulleys to the head through a Carlisle-Johnson friction clutch, which is very sensitive and permits of instantaneous forward or reverse movement. Power is transmitted directly from the countershaft pulleys through spur gearing of various ratios to the spindle. Most of the gearing of the headstock is machined from 60-point carbon steel forgings, the bull gears having teeth of 4 diametral pitch in the 16-inch machine. Speed changes are obtained through sliding gears which are controlled by five levers, the gearing being as nearly fool-proof as possible and running in a bath of oil, which insures proper lubrication of all parts in the headstock. The spindle bearings and other bearings, regardless of how low the rate of rotation, are supplied by sight-feed oil-cups and tubes, making it readily apparent which bearings are obtaining the proper lubrication and which are not.

At the right end of the relieving machine there are two quadrants, one for change-gears for such leads as may be desired up to approximately 6 inches, and the other controlling the cam driving shaft which extends along the back of the machine. These change-gears correspond with the number of gashes or with the spiral of the gashes, as the case may be. The rear cam driving shaft is driven through change-gears from a stud in the rear end of the headstock, this stud obtaining its power directly from the large bull gear, although it rotates at six times the speed of the spindle at all times. By means of a ratchet dog on the camshaft, the cam movement is suspended while reversing the spindle, and is ready to continue its rotation at the proper point when the spindle is again run forward. This cam driving shaft extends the entire length of the machine, and is supported in bearings at both ends. From it power is taken to rotate the cam arbor driving mechanism at the back of the carriage, as well as the driving mechanism for the side relieving cam. Adjustments are provided to make it possible to time the two cams either in unison or independently, as may be desired. The side relieving attachment causes the entire carriage to move while the regular relieving arrangement causes the cross-slide to move.

The carriage cross-slide and the compound slide are liberally proportioned to take the tremendous force which can be transmitted through the spindle. The tool-block, which in itself is a horizontal slide, is made of carburized cast

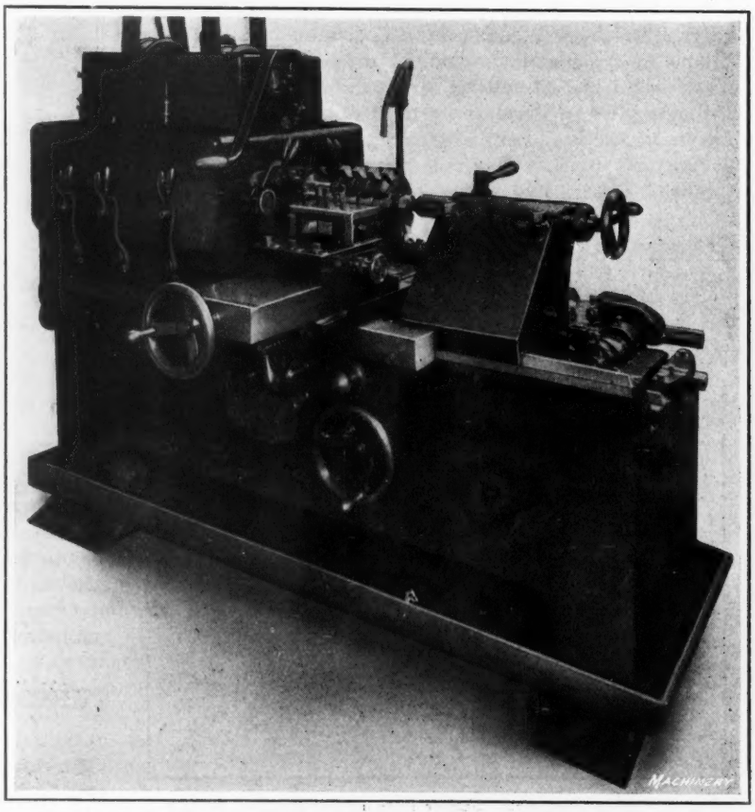


Fig. 1. "Hack" High-power Universal Relieving Machine built by the American Machine Tool Engineering Works

steel, hardened and ground on all working surfaces, thus insuring a rigid, accurate tool-block. The design permits of making micrometer adjustments when required or the tool-block may be securely locked. A safety device within the headstock prevents the carriage from being run against the headstock by accident. Likewise, a safety device on the tailstock prevents running the carriage into the tailstock. The tailstock is made in one piece, permitting of absolute alignment with the spindle at all times. No provision is made for handling tapered work. When taper relieving becomes necessary, a special spindle with an offset center may be furnished. The bolts and clamps for the tailstock are of such proportions as to make the tailstock as rigid as the headstock.

The carriage is actuated by means of a rack and pinion movement within the apron. A special mechanism is incorporated within the apron to provide for concave relieving, the purpose of which is to relieve the bulge or barrel effect which occurs in all hobs and cutters several inches in width, as the result of hardening. The arrangement of this feature is such that where three hobs or more of a kind are placed upon the relieving arbor, each hob can be produced with a concave contour corresponding exactly in curvature and depth with that of the other hob in that set; or where one large hob is being made, the curvature can be distributed in its proper form over the entire length of the long hob. This curvature is controlled entirely from the mechanism within the apron and can be readily adjusted and set up for any desired length or depth of curvature. This relieving machine is completely universal, and is capable of relieving spiral- or straight-gashed hobs, plain formed cutters and right- or left-hand counterbores, as well as performing internal relieving operations on special tools when such may be required. The weight of the 16-inch machine is approximately 8000 pounds. Its capacity is such that it will take a cutter 14 inches in diameter or one 16 inches long. However, cutters of 6 inches in diameter or smaller can be successfully relieved upon this machine. For work varying in diameter from 6 to 10 inches, the 10-inch machine is recommended, and for work smaller than 6 inches in diameter, the 6-inch machine is capable of answering all requirements.

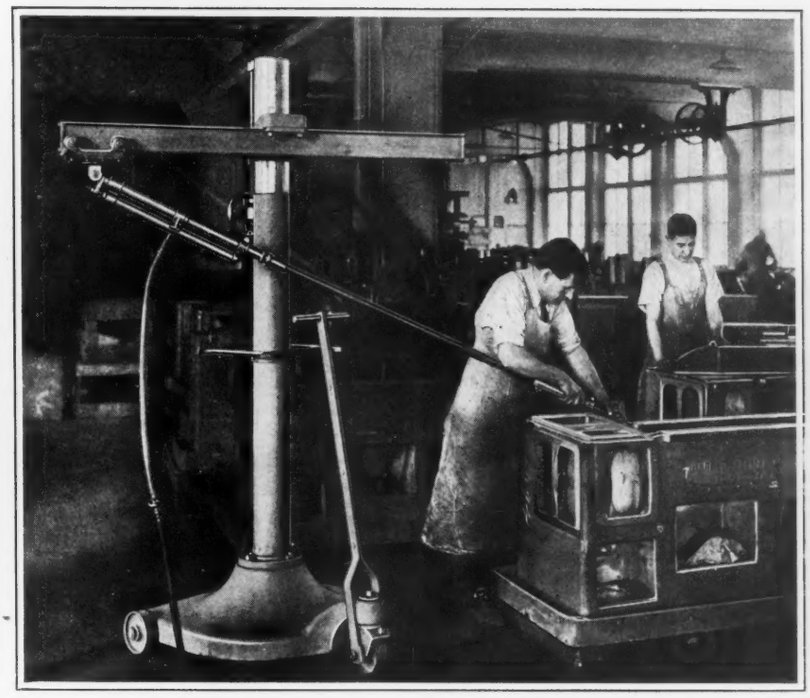


Fig. 1. Air-driven Scraping Tool made by the Anderson Bros. Mfg. Co.

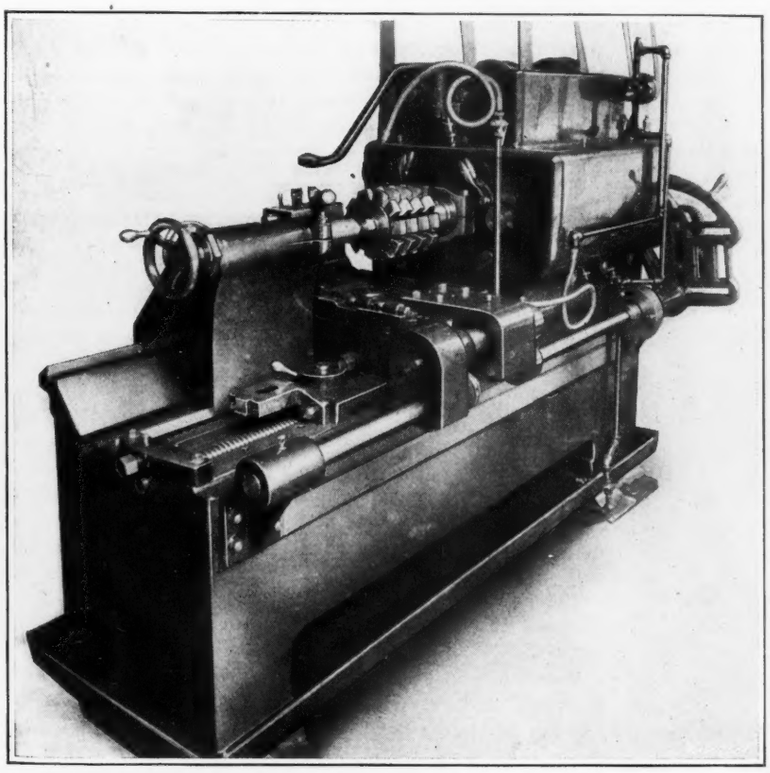


Fig. 2. Opposite Side of the "Hack" Universal Relieving Machine shown in Fig. 1

ANDERSON AIR-DRIVEN SCRAPER

For use in scraping the surfaces of machine members, the Anderson Bros. Mfg. Co., 117 Morgan St., Rockford, Ill., is now building an air-driven scraping tool which is here illustrated and described. The claims made for this equipment are that it greatly reduces both the amount of time and the physical effort required of the workman in scraping machined surfaces down to a perfectly accurate fit. The scraping tool is carried at one end of a long arm, and the air cylinder, piston, and other parts of the mechanism which operate the tool are located at the opposite end of this arm. In order to facilitate the manipulation of the tool, this air cylinder and its auxiliary mechanism are carried by a trolley which may easily be run back and forth on the supporting rail in order to enable the scraping tool to reach exactly the desired position on large pieces of work. The operator holds the scraping tool firmly down onto the work with the left hand, and the right hand is used to manipulate a knurled sleeve which actuates a valve in the air cylinder. When this knurled sleeve is pushed forward it allows the air to enter the cylinder and forces the scraping tool forward. As the only effort required of the operator is to hold the tool down onto the work, he is relieved of the additional effort of pushing the tool forward, and as a consequence he does not become so tired during the latter part of the day that his working efficiency is greatly reduced.

Having made this preliminary statement of the way in which the Anderson scraper

is used, we are ready to present a brief description of its operating mechanism. The trolley rail and trolley, by which the heavy end of the tool is supported, will be seen in Fig. 3, and the scraping tool is secured at *A*. The views in Fig. 3 are arranged as shown to illustrate the design in more detail, but attention is drawn to the fact that when the tool is ready for use, threaded fit *B* is assembled into socket *C*, and a pin passes through hole *D* at the right-hand end of the valve rod and hole *D* shown in the lower view, in order to provide for connecting the valve rod with knurled sleeve *E* which controls the operation of the scraping tool. When the knurled sleeve *E* is pushed forward, it opens valve *F* and allows air to enter the space *G* in the cylinder behind the piston.

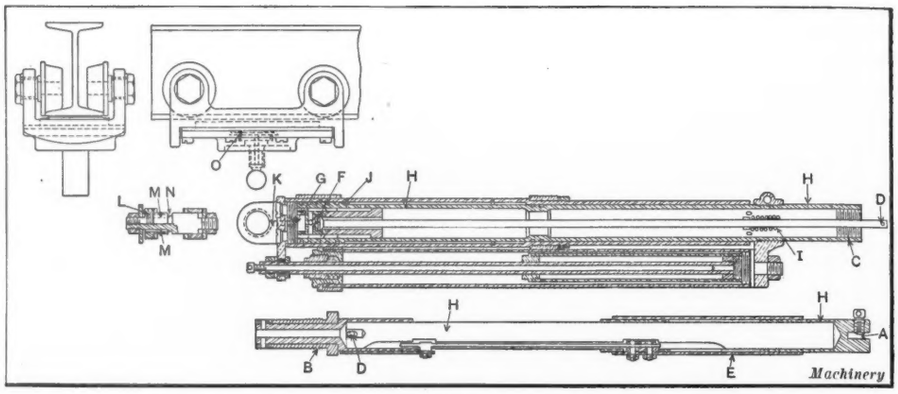


Fig. 3. Mechanism of the Anderson Air-driven Scraping Tool shown in Fig. 1

It will be seen that the piston is connected by means of parts, all of which are marked by the reference letter *H*, with the scraping tool which is mounted at *A* at the right-hand end of rod *H*. When knurled sleeve *E* is pushed forward to open valve *F* and admit air behind the piston, it causes the piston to move forward, and through this direct connection a similar forward movement is imparted to the scraping tool carried at *A*. The length of stroke may be governed either by releasing sleeve *E* when the tool has reached the desired point on the work, or by allowing the piston to travel forward until such a time as it reaches the exhaust ports which allow the air pressure behind the piston to be released. The valve *F* is normally kept in the closed position by means of a spiral spring *I*, and when the valve is closed, back pressure of air against shoulder *J* on the piston causes the piston and the scraping tool to be returned to the starting position.

When the scraping tool starts to move forward on its working stroke, it would be undesirable to have the trolley which supports the back end of the tool move along the rail. This possible cause of trouble has been effectually overcome by providing an automatic clamping mechanism which locks the trolley to the rail at the same time that the scraping tool starts on its working stroke. The way in which this result is accomplished is as follows: When valve *F* is opened to admit air behind the piston, some of the air also passes through port *K* to the swivel joint between the air cylinder and the trolley. Just below the trolley there will be seen a detail view of the bolt which connects the back end of the air cylinder to the trolley. After passing through port *K* the air enters an annular space *L* beneath the nut on this bolt and thence passes through ports *M* to reach an annular groove *N* that is cut around the body of the bolt at the center. From this annular space the air passes up to a diaphragm *O* which locks the trolley to its rail during the time that the air pressure is admitted to provide for driving the scraping tool forward. When valve *F* in the air cylinder is closed to shut off the pressure and stop the working stroke of the tool, the air pressure on diaphragm *O* is also released so that the trolley is free to move and allow the scraping tool to reach any other desired point on the work.

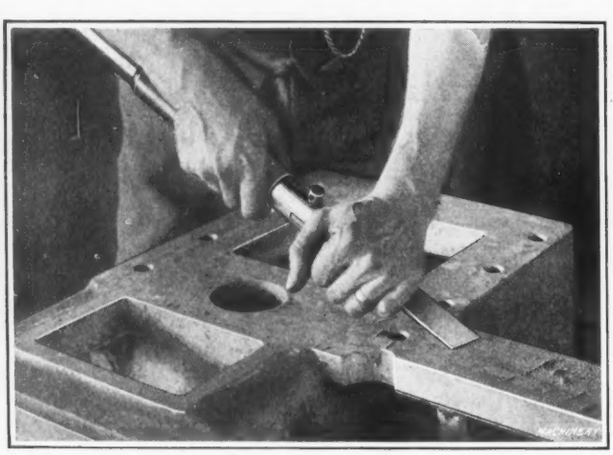


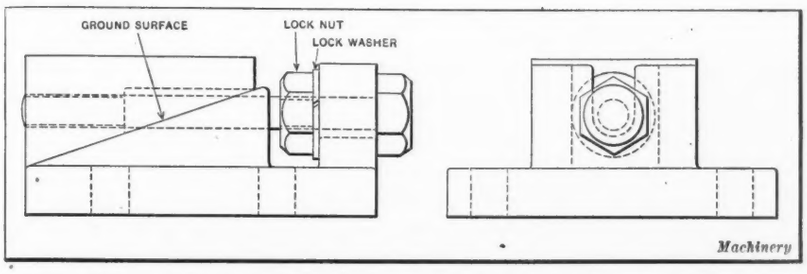
Fig. 2. Close View of the Scraping Tool and Sleeve that controls its Operation

The speed of the forward stroke of the scraping tool is regulated by an oil governor. About eight cubic feet of free air per minute, at a pressure of eighty to ninety pounds per square inch is consumed in operating this tool. The rod that carries the scraper is mounted on ball bearings, so that it may be turned over to enable both sides of the tool to be used in the same way that a hand-operated tool is employed. This arrangement also enables the tool to adjust itself to the work, regardless of the angle of the surface that is being scraped. Mention has been made of the fact that the air cylinder which operates the tool is supported by a trolley. The rail on which this trolley is carried may be supported in any convenient way; it may either be secured to the ceiling of the shop or mounted upon a special pedestal base provided for that purpose. This pedestal enables the height of the rail to be adjusted to suit different requirements. Another convenient auxiliary equipment for use in connection with this air-driven scraping tool is a turntable provided with T-slots for clamping the work to be scraped. This table is mounted on ball bearings, so that it turns easily, and a foot-treadle furnishes an easy method of clamping the table in any position from which the work can be most easily reached to scrape a given surface.

CINCINNATI PLANER LEVELING BLOCK

An improved type of leveling block for use in setting up planers has recently been placed on the market by the Cincinnati Planer Co., Cincinnati, Ohio. It is a matter of general knowledge that a planer must be set up on a perfectly level and rigid foundation in order for it to continue to give satisfactory service; and under the severe conditions of load and vibration to which the foundation blocks used for supporting machines of this type are subjected, trouble has often been experienced through their showing a tendency to shift, even where the precaution has been taken of grouting the blocks in concrete. Any such shifting of the blocks upon which a planer is mounted naturally throws the machine out of level.

The new style of Cincinnati planer leveling block is so designed that it eliminates the cause of trouble to which reference has been made. This improved block consists of a baseplate and a sliding member which is actuated by a draw-bolt that is furnished with a thread of fine pitch, a lock-nut and a washer. The baseplate is cast with a wide flange, and it is drilled with four 1-inch holes which are found to be of great assistance in helping to grout the block



Improved Type of Planer Foundation Leveling Block made by the Cincinnati Planer Co.

in place. The inclined surfaces of both the baseplate and sliding member are ground to a perfectly smooth surface, so that they slide freely on each other; and this feature in conjunction with the fine pitch of the thread of the draw-bolt greatly facilitates the making of accurate adjustments. The draw-bolt is ⅞ inch in diameter and it is threaded for practically its entire length in order to accommodate the lock-nut. The design of the block is worked out in such a way that 2½ inches of the thread on the bolt are engaged at all times, so that ample holding power is assured. With a block of this kind, accurate settings can be easily made, after which the lock-nuts are tightened so that vibration will not tend to cause the blocks to shift and throw the planer out of level.

HART UNIVERSAL PLATE CASTER

For rapid and efficient manipulation of plates in shipbuilding plants a universal caster is indispensable. It is customary to have these casters mounted on pipe standards a few feet above the floor and only a short distance apart for a large area in front of shearing, punching, or forming presses. The Hart Roller Bearing Co., 510 Main St., East Orange, N. J., is now placing on the market the universal caster which is illustrated herewith. It comprises four important parts: a cast-iron base, three roller bearings, a large ball, and a cover. The base is made of cast iron and is finished with a plain surface on the bottom with a central binding screw for attaching it to a table. The base is provided with three adjusting screws fitted with lock-nuts. These are for leveling the bearing on an irregular surface. The base is also made, when desired, with a tapped pipe flange on the bottom so that it may be screwed to a pipe standard.

The three roller bearings with which the large ball contacts are held between the lugs on the base by shafts which are held in place by pins. The shafts are drilled out with an oil reservoir which may be filled with a sufficient quantity of oil to last for an indefinite period. The ball is a high-class mechanical bearing ball of the Hoover make. The cover is of cast iron, equipped with three cone-pointed headless set-screws which contact with the V-groove around the flange of the base, holding the cover securely in place. The cover fits the caster in a manner which excludes a large percentage of dirt, but the construction is such that it will permit an enormous amount of dirt to come through the cover before it effects the mechanical working of the caster. The Hart universal plate caster is now made in two sizes, which are furnished with 4-inch and 3-inch balls.

Fig. 1. Hart Universal Plate Caster

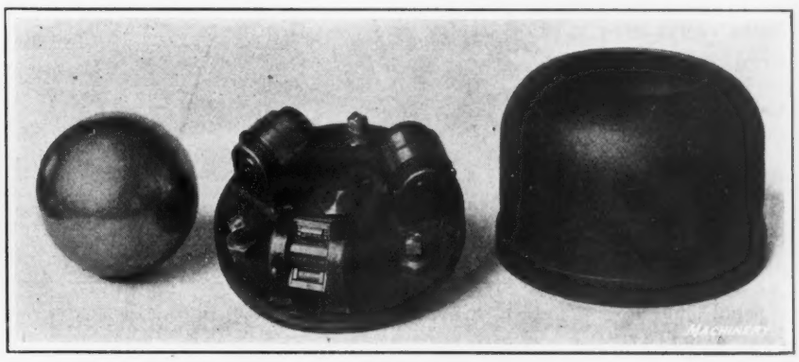
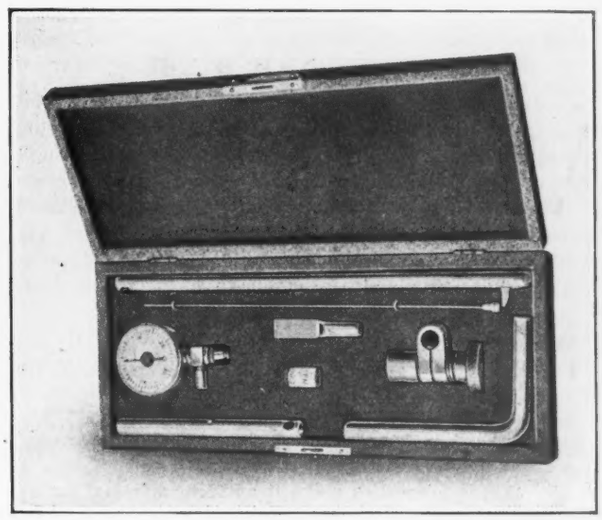


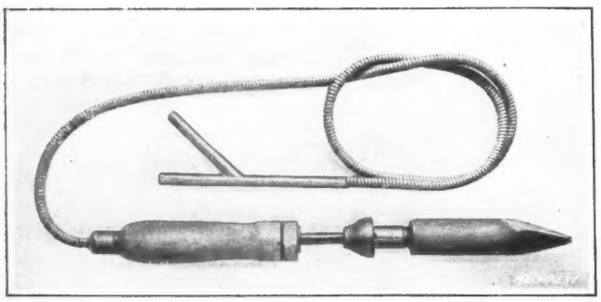
Fig. 2. Parts of the Hart Universal Plate Caster shown in Fig. 1

CORNELL DIAL TEST INDICATOR

A dial test indicator which has recently been placed on the market by the Cornell Tool Co., Detroit, Mich., is shown in the accompanying illustration. Indicators of this type are made in two sizes, namely, a No. 1 instrument which is adapted for use in the tool-room and a No. 2 instrument which is suitable for meeting the requirements of general production work. Both sizes are regularly furnished with a complete set of attachments. It is stated that these indicators are of simple design and that they are so constructed that there is no chance for them to lose their original degree of accuracy. An important feature of the design is that the dial is mounted on a universal joint so that the operator is always able to have the dial located in a position where it may be easily seen. This construction makes it unnecessary to resort to the use of a small mirror in order to gain a view of the dial when indicating parts where the dial would otherwise be located face downward or away from the operator. Attachments are furnished with these indicators which enable them to be employed with a height gage or to indicate internal work down to ⅜ inch and up to 8 inches in depth. The graduations on the dials are spaced at a sufficient distance apart so that they can be easily read, even in places where the light is bad. The No. 1 instrument will indicate 0.135 inch and the No. 2 size will indicate 0.235 inch. The F. Conley Co., 502 Book Bldg., Detroit, Mich., is the sole distributor of these indicators.



Cornell Dial Test Indicator distributed by the F. Conley Co.



Self-heating Soldering Copper made by the Self Heated Solder Iron Co.

SELF-HEATED SOLDERING IRON

To avoid the necessity of using gas stoves or other means of heating soldering coppers, the Self Heated Solder Iron Co., 420 E. 6th St., New York City, has placed on the market a tool which is shown in the accompanying illustration. It will be apparent that a flexible tube is provided through which gas and air are carried to the combustion chamber. At the end of this flexible tube there is a double coupling which provides for making connection with the gas pipe and with a compressed air pipe, respectively. By making suitable adjustment of the nozzles through which gas and air pass to the tool, the required mixture and pressure may be obtained to maintain the soldering copper at the desired temperature. Close to the conical-shaped shoulder between the wooden handle and the copper point of the tool, there will be seen a small semi-circular shaped hole, this being one of three similar shaped holes that are provided for lighting the tool. In the body of the copper there is a "peep hole," and the pressure of the gas and air must be so adjusted that the point of the flame comes just opposite this hole. After impinging upon the end of the combustion chamber in the copper, the products of combustion pass back and escape through two ducts at each side of the tapped hole into which the shank of the tool is threaded.

"KINITE" TOOL STEEL

A tool steel called "Kinite" that may be cast directly into the shape of a tool or die, instead of being forged, and which is said to possess the valuable property of not changing shape or size during hardening, has recently been developed by the Kinite Co., Milwaukee, Wis. This steel is cast in specially prepared molds and has the appearance of a good smooth forging. A peculiar property is that it does not elongate under tensile strain nor decrease in cross-sectional area. It retains the shape and size that is desired until the breaking point is reached. Castings made from "Kinite" are free from the defects and blow-holes usually found in castings. Unlike all other high-speed steels, it contains no tungsten. It will harden better than many forged products, and when hard is very uniform, dense, and close-grained. It is high in heat-resisting qualities and does not scale in the fire. These properties make it an ideal material for use in making milling cutters, dies, taps, and other tools having multiple cutting edges. As "Kinite" castings do not change their form during the hardening process, it is possible to make them so near the desired shape and size of the finished tool or die that very little machining or labor is necessary for completion. Dies requiring one or more holes are made with the holes cast in them, thus saving the cost of waste material and the labor involved in working the holes.

The unusual characteristic of this steel in not changing shape or size during the hardening operation makes it possible to produce large dies in one single piece; and the claim is also made that this practice saves from 20 to 70 per cent of the labor necessary to finish such dies after they are cast. "Kinite" is also valuable for making machine parts that must resist heat and wear, and which are subject to abrasive action while in service. It has been found that annealing boxes can have much thinner walls when made of this material and that they retain their shape and original weight through many more firings than when cast or malleable iron is used. Castings made from "Kinite" can be annealed and rehardened many times, without losing any of their original physical properties. After proper annealing, they show a hardness of about 38 scleroscope, and at this hardness can be machined readily at a cutting speed of 25 to 30 feet per minute. "Kinite" anneals and hardens at about the same temperature, namely, 1840 degrees F. A stove company in Cleveland, Ohio, is using for the second season, a "Kinite" punch and die to blank out stove legs from 3/16-inch black unannealed steel. On an average, over 200,000 pieces have been produced per grind and the die is still in good condition. Evidently, this is the means of effecting economy in the cost of die maintenance.

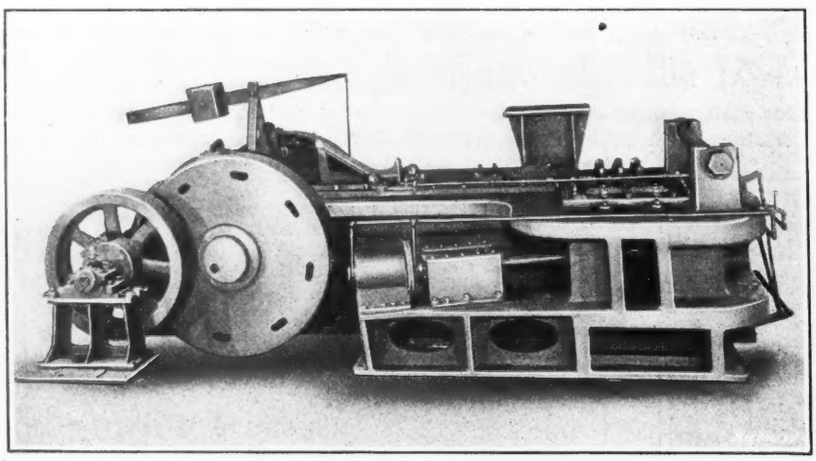


Fig. 1. Upsetting Forging Machine built by the Ajax Mfg. Co., which has Unusually Large Stock Gather

AJAX UPSETTING FORGING MACHINE

Among the numerous unusual forgings required in the construction of artillery was one which could be most economically produced by means of an upsetting forging machine providing an extra large stock gather, or, in other words, a stroke of 20 inches after the gripping die closes and thus holds the stock while the upsetting ram or tool performs its upsetting operation. The Ford Motor Co., which had contracts for enormous quantities of government sup-

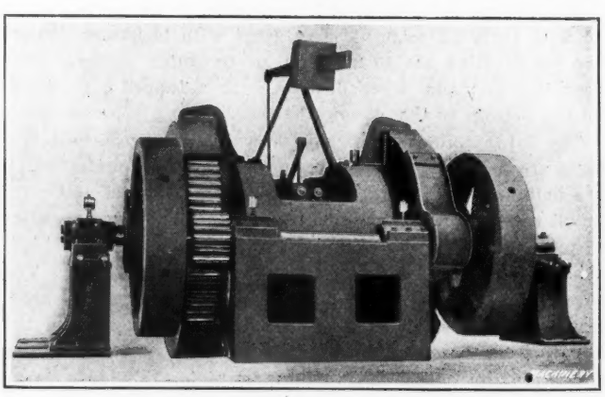


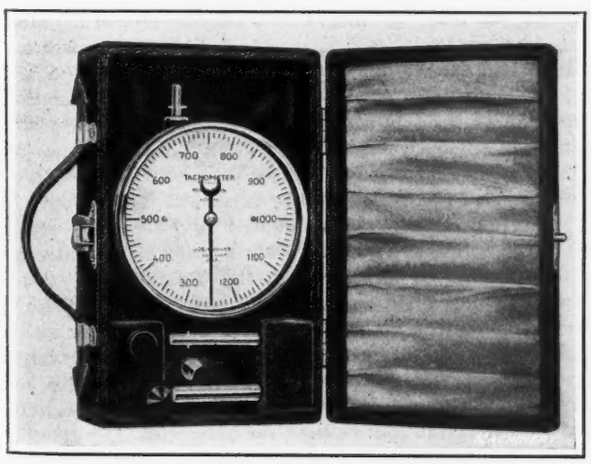
Fig. 2. End View of Ajax Forging Machine shown in Fig. 1

plies, quickly appreciated the possibilities of producing this particular artillery forging by the upsetting method, and forthwith put the problem up to the Ajax Mfg. Co., Cleveland, Ohio, to furnish a special machine to meet the requirements. This was accomplished in due time by the production of a large forging machine in which the moving gripping die is operated by an air cylinder and the heading tool or ram has a travel of 24 inches after the dies have closed. This extra long stroke can be increased in case of emergency to 26 inches.

The die space will take a die 25 inches high by 27½ inches long. The crankshaft has a gear on each end, thus giving a double geared drive and eliminating torque in the crank. The diameter of the crank is 13 inches and the air cylinder operates under 100 pounds pressure. The floor space is approximately 24 feet by 15 feet, and the total weight of the machine, complete, is a little over 200,000 pounds.

JONES-MOTROLA HAND TACHOMETER

The hand tachometer which is illustrated in connection with the following description, is one of the latest additions to the line of instruments made by Jones-Motrola, Inc., 29-33 W. 35th St., New York City. As this tachometer is portable, it may be readily employed at any point in the plant where it is desired to test the speed of rotation of a shaft, pulley, cutter-arbor or other rotating member. It is known as a Type H-2, and is provided with one of the standard tachometer heads of this company's manufacture. The instrument is usually held in the palm of the hand, but a handle can be provided as a special attachment, if so desired. It will be apparent from the illustration that the graduations on the dial are spaced a sufficient distance apart so that they may be easily read, even in places where the light is bad. The body of the instrument is japanned black, and the fittings are nickel-plated. It is stated that this instrument is especially valuable for use where the speeds to be measured cover a wide range. Three standard dials are made for use on the tachometer, which are graduated for the measuring of speeds within the following ranges: 100 to 1200, 500 to 2500, and 1000 to 5000 revolutions per minute. Auxiliary equipment furnished with the tachometer includes a triangular steel tip and a center punch, a rubber tip, a rubber funnel cup for use on pointed shafts, and an extension rod. A morocco carrying case is provided with the instrument.



Hand Tachometer made by Jones-Motrola, Inc.

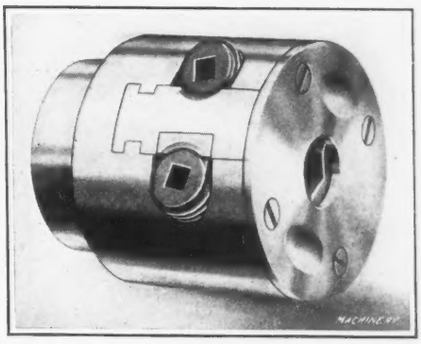


Fig. 1. Twin Screw Drill Chuck made by the Marvin & Casler Co.

MARVIN & CASLER DRILL CHUCK

In the accompanying illustrations is shown the Casler twin screw drill chuck, which is a recent product of the Marvin & Casler Co., Canastota, N. Y. The body of this chuck is made of close-grained cast iron, and the jaws and screws are of tempered high-carbon steel. The claim is made that the combination of cast iron and steel gives long life to the wearing surfaces between the body, jaws, and screws. It will be seen that the body is reinforced by a steel cap plate, which prevents it from spreading when under strain; and a secondary screw doubles the grip of the drill chuck jaws and allows the drill to be driven to the limit of its strength. When using the chuck, the primary screw *E*, Fig. 2, is first operated to grip the drill shank between the jaws, and after this primary screw has been set up, the secondary screw *D* is operated to bring the floating nuts *C* against the ends of the pockets in the jaws *B*. The tightening of this secondary screw *D* results in producing a grip on the drill shank that is claimed to be twice as great as that obtained from a single screw. All parts of the chuck are made interchangeable to facilitate replacement, and there are no projections likely to catch the work or injure the operator.

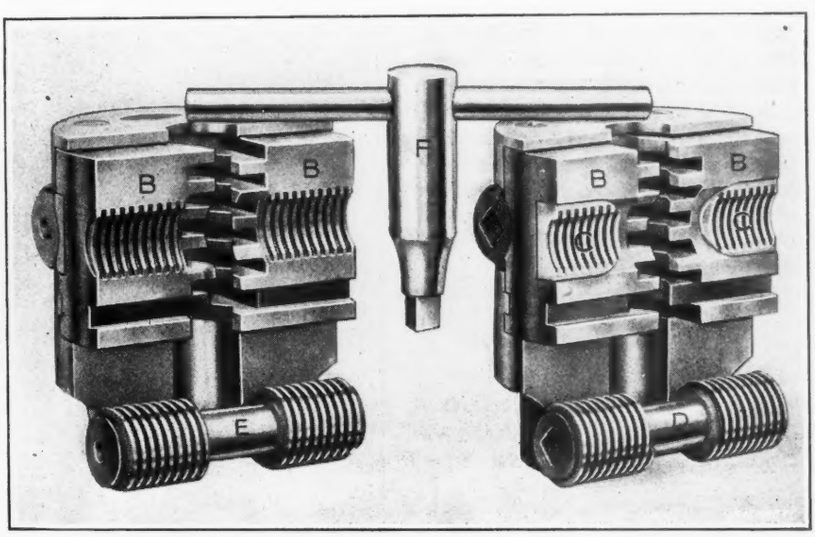
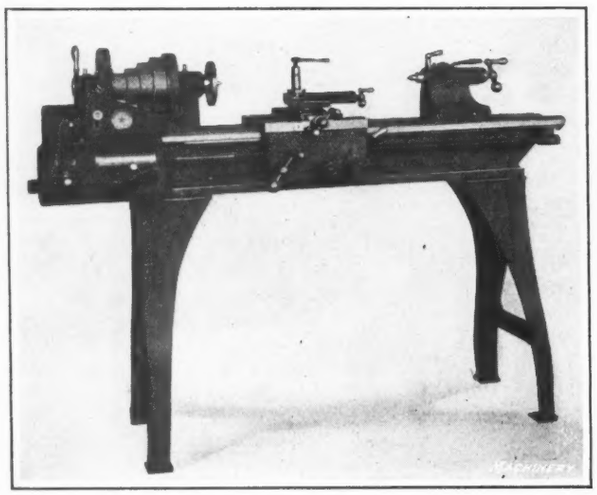


Fig. 2. Mechanism of the Marvin & Casler Drill Chuck shown in Fig. 1

SENECA FALLS QUICK-CHANGE LATHE

The Seneca Falls Mfg. Co., Inc., 381 Fall St., Seneca Falls, N. Y., has recently added to its line of "Star" lathes an 11-inch quick-change engine lathe, which is here illustrated and described. This machine is equipped with a quick-change gear mechanism consisting of a train of nine gears arranged in the form of a cone mounted on the lead-screw, the gears being enclosed in a box controlled by a single tumbler handle. By means of another tumbler carrying a set of compounding gears, the train is given different speeds, thus providing forty-five changes of feed, or for cutting from three to ninety-six threads per inch, including the 11½ pipe thread. Any desired thread which is not given on the index plate may be obtained by using the necessary change-gears on the feed



"Star" Quick-change Lathe made by the Seneca Falls Mfg. Co.

stud. The construction is very simple, and the drive is direct through a minimum number of gears from the headstock spindle to the lead-screw, so that there is very little unnecessary absorption of power. The headstock carries a hollow spindle, which has a hole one inch in diameter extending through it. This spindle is made from 60- to 65-point carbon crucible steel. Liberal sized bearings are provided for the carriage on the ways, and the carriage is gibbed at both the front and the rear. It is provided with power cross-feed. A safety device in the apron makes it impossible for two movements to be engaged simultaneously. This lathe may be provided with motor drive, taper attachment, draw-in chuck, oil-pan and pump, turret carriage stops, milling and gear-cutting attachments, etc.

PRESSED METAL MACHINERY CO.'S "SPINHAMMER"

With the view of combining in a single machine provision for the performance of rivet-upsetting operations and an air hammer to drive the rivets into place, the Pressed Metal Machinery Co., 15 S. Clinton St., Chicago, Ill., has developed and placed on the market an equipment known as the "Spinhammer." A small air hammer is built into the frame of the machine, and the rivet-set is constantly rotated by means of worm-gearing connected with a small pulley located on the right-hand side of the head, which is driven by a belt from a ⅛-horsepower Robbins & Myers motor secured to the frame of the machine. Adjustment of the stroke or travel of the head may be made for rivets of different lengths, etc., by merely raising or lowering a thumb-nut which is located under a trigger opening, and closing or opening the air valve, the trigger being thrown into action when the upper arm is pulled down against it by depressing the foot-treadle. All parts of the machine are liberally proportioned to operate on any air pressure between 60 and 120 pounds per square inch. Machines of this kind are built in two types, both of which are made with a 12-, 18-, 24- or 30-inch throat. The

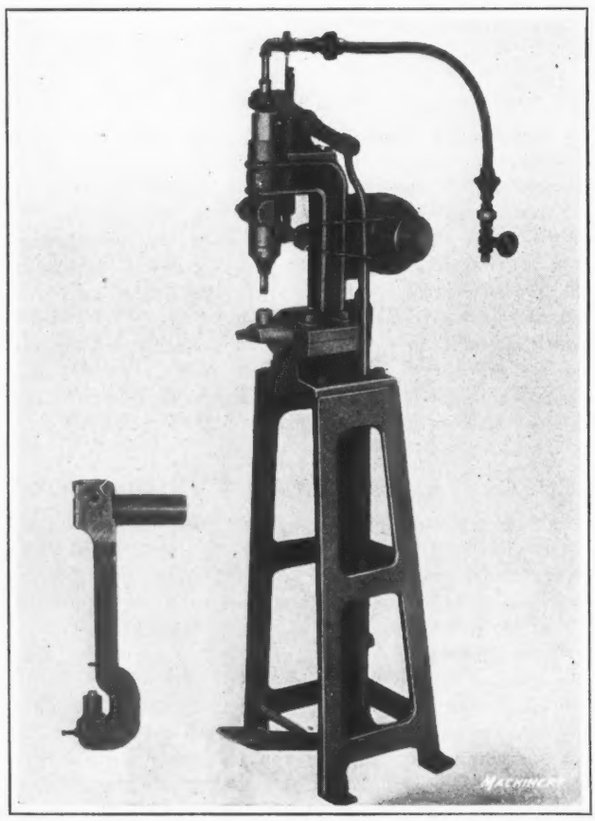


Fig. 1. "Spinhammer" built by the Pressed Metal Machinery Co.

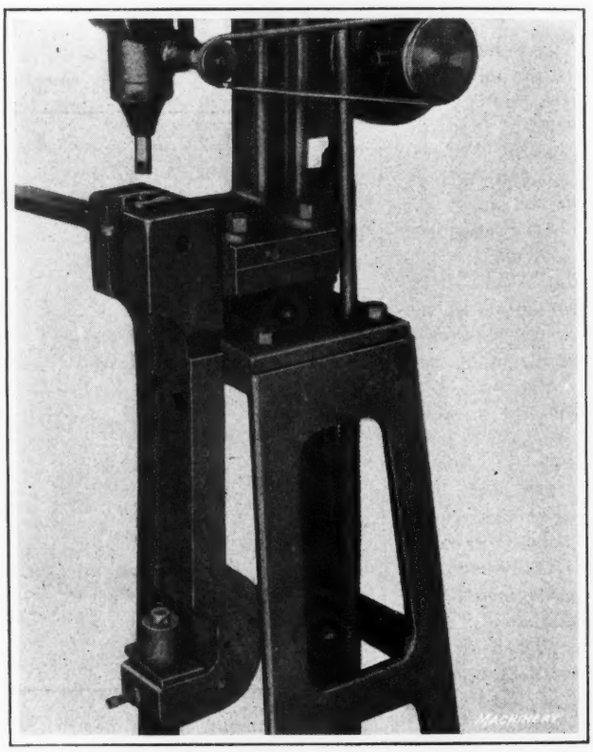


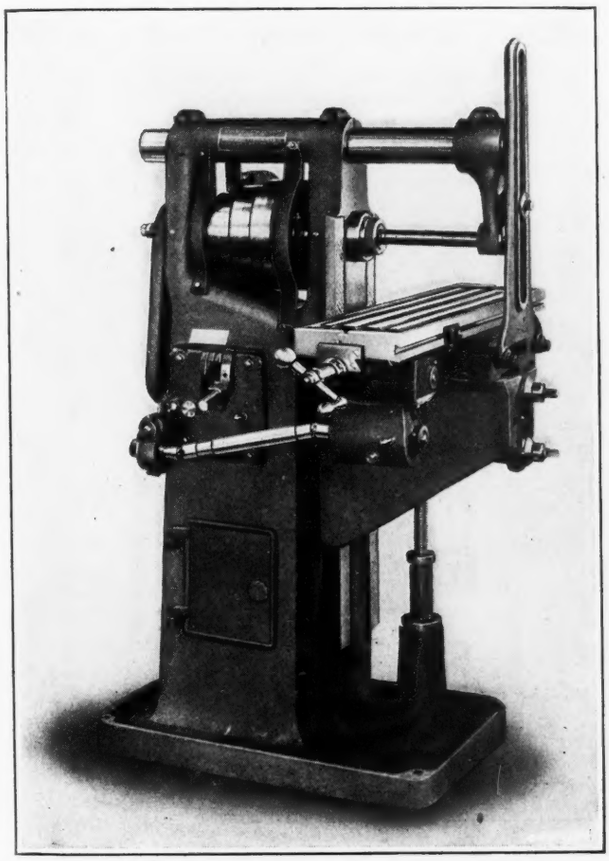
Fig. 2. Close View of Mechanism of "Spinhammer" shown in Fig. 1

light type will upset rivets up to ⅜ inch in diameter, and the heavy type has a capacity for upsetting rivets up to ⅝ inch in diameter.

In working out the design of this machine, provision has been made for constructing the lower part of the frame to permit of using interchangeably the standard lower arm or mandrel for plain riveting, and a regular drop-arm fixture with open and shut jaws to provide for heading spokes and similar long pieces, which must project through the arm and still be rigidly clamped during the riveting operation. The hammer head is so arranged that it will always stop at the top of its stroke, thus providing ample clearance for quickly inserting or removing the work without any interference. These machines can be furnished either singly or in gangs for setting up any number of rivets at a single stroke, the action of all of the riveting heads being controlled by one treadle. It is stated that the "Spinhammer" is admirably adapted for the performance of various heading and riveting operations on rivets and studs used in the manufacture of hardware specialties, locks, hinges, wire wheels, clutch transmissions, and various parts of automobiles and tractors, agricultural implements, cutlery, steel furniture, etc. In general, it may be used for practically any riveting operation which comes within the throat and power capacity of the machine.

DAVENPORT PLAIN MILLING MACHINE

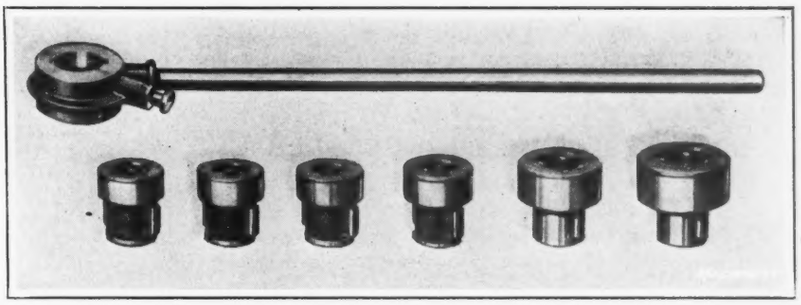
The No. 2-B back-geared plain milling machine which forms the subject of the following description is a recent product of the Davenport Mfg. Co., Meadville, Pa. A feature of the design is that the working surface of the table on this machine extends over its full length and width, which are 38 and 10 inches, respectively. Three T-slots ⅝ inch in width are machined in the table. The feed movement is accomplished by means of a screw, which gives a forward movement of ¼ inch for each turn of the handle; and there is a quick return of 1¼ inch for each rotation of the crank at the end of the table. The spindle is 2½ inches in diameter by 4¾ inches long in the front bearing, and has a No. 10 B. & S. taper hole in the nose, and a



No. 2-B Back-geared Plain Milling Machine built by the Davenport Mfg. Co.

hole 11/16 inch in diameter extending through the spindle. The spindle nose is 2¼ inches in diameter and threaded with ten right-hand threads per inch. The driving cone pulley has three steps 7.73, 8.86, and 10 inches in diameter, respectively, and carries a 2¼-inch double belt. The ratio of the back-gears is 4.57 to 1. Twelve changes of spindle speed are available, which run in geometrical progression, from 20 to 350 revolutions per minute. The feed-box provides twelve changes of feed ranging from 0.004 to 0.047 inch per revolution of the spindle. All the gears in the feed-box are made of a special alloy steel, and the drive to this box is through a roller chain from the spindle. All feed changes are obtained through three levers, and reversal of feed is obtained through a push-rod on the feed-box. The tripping mechanism is of the plunger type.

Principal dimensions of this machine are as follows: Diameter of overhanging arm, 3¼ inches; distance from underside of over-arm to center of spindle, 6⅜ inches; number of countershaft speeds, 2, namely, 123 and 270 revolutions per minute; dimensions of clutch pulley, 10 inches in diameter by 3½ inches face width; diameter of countershaft, 1 9/16 inch; dimensions of arbor, 1 inch in diameter by 10 inches between shoulder and nut; dimensions of vise jaws, 6¼ inches wide by 1½ inch deep; maximum opening of vise, 3½ inches; extreme floor space occupied by machine, 48 by 75 inches; and net weight, approximately 1900 pounds.



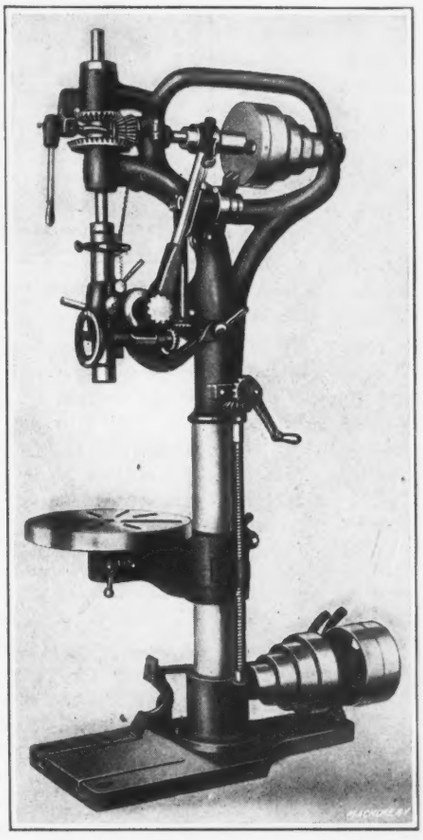
"Beaver Junior" Pipe Threader made by the Borden Co.

BORDEN "BEAVER JUNIOR" PIPE THREADER

The Borden Co., Warren, Ohio, has recently added to its line of "Beaver" die-stocks and pipe-cutters, a new pipe-threading device which is known as the No. 3 "Beaver Junior." This tool is built on the unit plan to provide for threading ⅛-, ¼-, ⅜-, ½-, ¾- and 1-inch piping. It consists of a ratchet handle and separate die-heads for threading the sizes of pipe mentioned. The whole outfit is packed in a wooden case so that it may be conveniently carried to the job. The ratchet mechanism is entirely enclosed, so that it is impossible for dirt or grease to clog the ratchet and retard the action of the tool.

RICHARDS DRILLING MACHINE

A 20-inch back-geared drilling machine which is equipped with back-gears, power feed, automatic stop and geared tapping attachment is one of the recent products of the Richards Machine Co., 3417-3419 Vliet St., Milwaukee, Wis. This machine has a capacity for drilling holes up to 1¼ inch diameter, and for tapping holes up to ⅞ inch in diameter. The ratio of the back-gears is 4 to 1, and these gears are enclosed in the upper cone pulley. Machines of this type may be provided with power feed mechanism equipped for either belt drive or geared drive. All of the gears in the tapping attachment are made of steel. Provision is made for backing the tap out of the hole at a speed



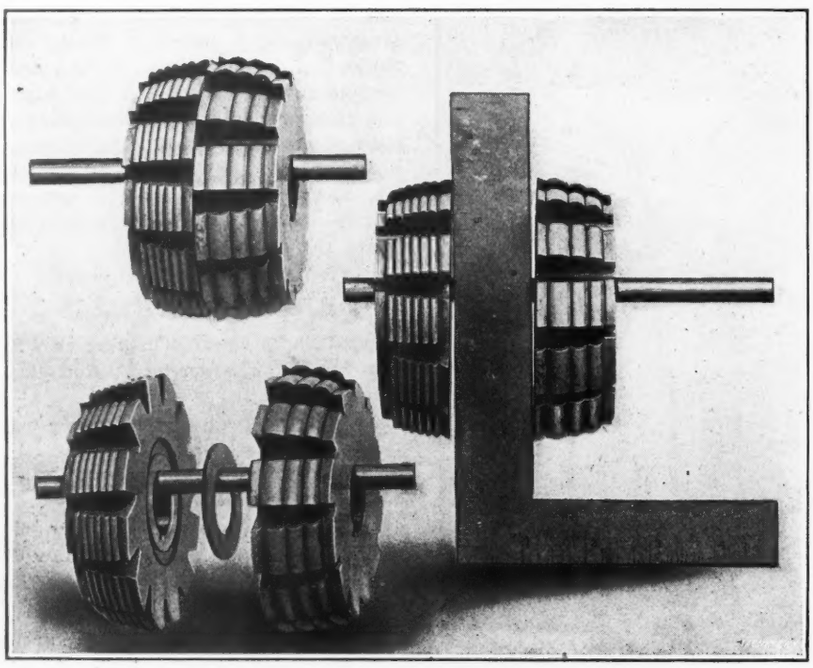
Drilling Machine built by Richards Machine Co.

approximately one-third faster than the forward speed; and reversal of the direction of rotation can be instantly accomplished while the machine is running, it being merely necessary for the operator to pull a lever.

BILTON SPLIT MILLING CUTTERS

Those mechanics who have had considerable experience in setting up milling machines know that where a gang of cutters is to be mounted on an arbor, the best results cannot be obtained unless the different cutters comprising the gang are so located in relation to each other that the teeth will come into engagement with the work in consecutive order, instead of having all the teeth engage and leave the work simultaneously. The reason for this method of mounting cutters is not difficult to understand. In all classes of machine work, shock and the vibration caused by shock are undesirable conditions, and if all the teeth of a gang of cutters come into engagement with the work simultaneously, the repeated blows which the work receives in this way is likely to make the cutters and work chatter.

In designing milling cutters having a considerable face width, the conditions to be considered are similar to those which must be taken into account when setting up a number of cutters on an arbor. If the formed cutter shown in the accompanying illustration were made in one piece it would be necessary to cut the spaces between the teeth right across the face of the tool, and this would result in producing the undesirable conditions of operation to which reference has been made. With the view of overcoming such difficulties, the Bilton Machine Tool Co., Bridgeport, Conn., is making these cutters split, as shown in the illustration. With such a construction, it is possible to locate one half of the cutter in such a relation to the other half that the teeth are staggered and come into engagement with the work, first at one side of the center line of the cutter and then at the other side. The two halves of the cutter are split at an angle, as indicated by the view in which a steel square is shown standing between them. This is necessary in order to have the corners of the cutting edges overlap each other to avoid producing a ridge at the center of the work. Also making a long cutter of this kind in two halves is desirable as it reduces internal strains set up during hardening.



Split Formed Milling Cutter made by the Bilton Machine Tool Co.

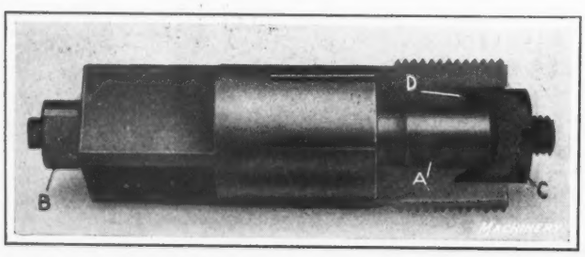


Fig. 1. Modern Tool & Machine Works Expansion Sizing Tap

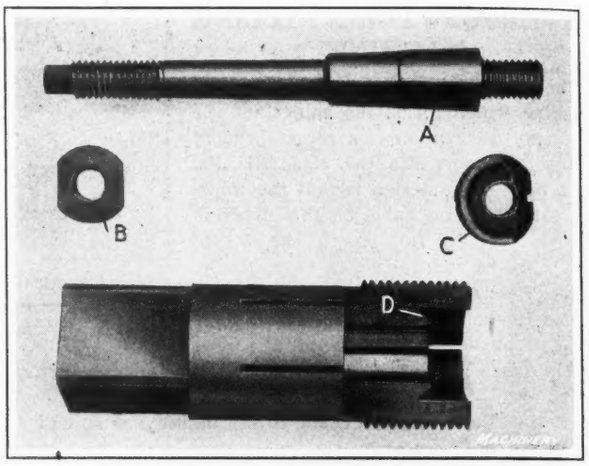


Fig. 2. Parts of Modern Expansion Sizing Tap, showing Method of making Adjustment

MODERN EXPANSION SIZING TAP

The accompanying illustrations show an expansion sizing tap which is a recent product of the Modern Tool & Machine Works, Inc., 344-350 Mulberry St., Newark, N. J. Fig. 1 shows an assembly view, with the body of the tap partially cut away in order to show the mechanism more clearly; and Fig. 2 illustrates the four parts of the tap, from which a better idea will be obtained of the way in which the tool is set to the required diameter. It will, of course, be apparent that the body of the tap is split in order that it may be expanded to the required size, through the action of a tapered section *A* of the expanding rod, which is drawn through the tap by means of nut *B*. In order to make the necessary adjustment, nut *C* is first slacked off in order to provide for tightening nut *B;* and after the tap has been set to the required diameter, nut *C* is again tightened in order to lock the tap to the required size. Nut *C* is counterbored to fit over the tapered surface *D*, thus locking the tap firmly down onto the tapered section *A* of the expansion bolt. The taps are ground to an accurate pitch, lead, and angle, and it is claimed that their pitch diameter can be held within 0.0002 inch of the required size.

FISHER-SMITH BALL TEST ARBOR

The tool which forms the subject of the following description is a recent product of the Fisher-Smith Co., Dayton, Ohio. It consists of a hardened and ground steel ball of standard size, which is mounted on an oscillating arm, the shank of the ball being of such size that it may be conveniently held in a standard chuck. It will be apparent from Fig. 2 that the ball acts as a measuring point, being easily and quickly trued up with the spindle of the machine. The arbor is provided with an adjusting screw which enables the

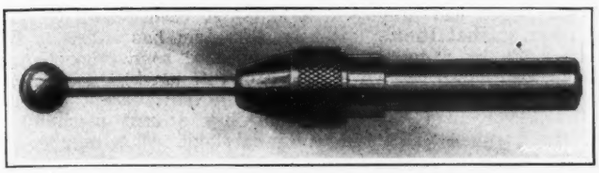


Fig. 1. Ball Test Arbor made by the Fisher-Smith Co.

user to put as much tension on the oscillating arm as may be desired. The body is knurled and casehardened. The purpose of this tool is to reduce the cost of performing precision boring operations of the kind that are necessary in making jigs and similar work. It is claimed that with the use of this tool, a predetermined position can be located with absolute certainty and within very close limits of tolerance. The advantage claimed for the ball test arbor over the floating button arbor is the greater ease and rapidity with which

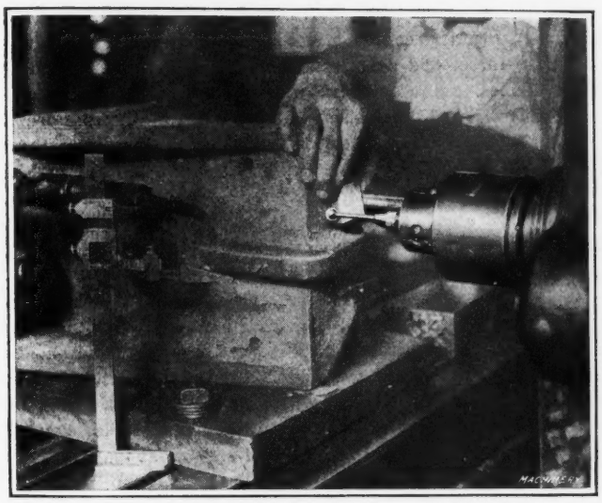


Fig. 2. Use of the Fisher-Smith Ball Test Arbor shown in Fig. 1

it may be trued up. The measuring point being a perfect ball, it will be evident that if one point runs true, the entire ball will also run true. There is a hair line over which to measure, thereby making it easy to work with a great degree of accuracy.

NEW MACHINERY AND TOOLS NOTES

Shop Table: Kent Machine Co., Kent, Ohio. An all-metal shop table which is adapted for use in holding tools, jigs, fixtures, and similar auxiliary equipment of the machine shop. The table has a top and lower shelf, so that ample holding space is provided.

Ball Bearing Lathe Centers: Kell, Hock & Co., 354 Mulberry St., Newark, N. J. A ball bearing tailstock center, with Nos. 2, 3, and 4 Morse taper shanks. This device is regularly furnished with a 60-degree center, but special centers may be furnished to order.

Open Side Planer: Simmons Machine Co., Inc., Albany, N. Y. A 42- by 42-inch by 12-foot heavy-duty open side planer, which has an actual capacity for holding work slightly in excess of the rated dimensions, namely, 42 inches wide by 46 inches under the cross-rail, and 13 feet long.

Thread Lead Testing Device: Arrow Tool Co., 200 Cannon St., Bridgeport, Conn. A device for use in testing the lead of thread gages, which is particularly used for testing the accuracy of thread gages and other work of a similar nature. This device was originally built for use in the Arrow Tool Co.'s shops, but it is now to be placed on the market.

Sine Bar: A. F. Way Co., Inc., Hartford, Conn. A sine bar that is provided with two rolls, on which all measurements are made, these rolls being inserted into right angle notches cut in the side of the sine bar. The rolls are held in place by a small coil spring passing through the side of the roll into the sine bar. Three holes are provided in the bar, by means of which it may be attached to an angle-plate.

Sand-blast Tumbling Barrel: American Foundry Equipment Co., Cleveland, Ohio. A small-sized self-contained sand-blast tumbling barrel, 30 by 36 inches, of the suction type. The barrel can be set up anywhere, the only connections necessary being the air pipe and dust-collector pipe. The cleaning is done entirely by sand-blasting, and the purpose of the tumbling is to expose all surfaces of the parts to the sand blast.

Tapping Attachment: John H. Dorman & Son, 1-9 Bethune St., New York City. A line of multiple-spindle tapping attachments which are made with various numbers of spindles to meet the requirements of special cases. The attachments are provided with a tapered shank, by means of which they may be mounted in an ordinary drilling machine. The case is made of aluminum to reduce weight, and the spindles are gear driven.

Blow Torch: North American Mfg. Co., Cleveland, Ohio. A portable high-temperature blow torch which is adapted to the requirements of a wide range of heating operations on work of various sizes. This torch comprises a mixing chamber, motor-driven fan, delivery pipe, and nozzle. Flexible tubing supplies gas from a service pipe, while a lamp socket connection and drop cord delivers electric current to the fan motor.

Lamp Guard with Split Handle: Flexible Steel Lacing Co., Chicago, Ill. A device known as the "Flexco" split-handle lamp guard, developed to meet the demand for a substantial split-handle lamp guard which does not have to be especially wired. The face of the guard and handle open on a hinge, thus enabling them to be instantly closed and locked around the socket at the end of an extension cord, which makes a connection to an electric circuit.

Thread Grinding Attachment: Presto Machine Works, 124 Pearl St., Brooklyn, N. Y. A thread grinding attachment which is adapted for use on a bench lathe, the range of external work being up to 6 inches outside diameter, and internal work up to 4 inches in diameter. The attachment is so constructed that the grinding wheel may be permanently located in relation to the center line of the work, and adjustment for diameter and depth of cut do not disturb the original setting.

Size Blocks: A. F. Way Co., Inc., Hartford, Conn. A line of size blocks have been developed with the view of placing a set of blocks within reach of every mechanic for his own personal use. These blocks are ground and lapped to sizes very slightly above the exact dimensions, which brings them within the commercial limits of accuracy on most classes of work. It is claimed that all of the Way blocks measure between their rated size and 0.0001 inch over size, making the combined error of five blocks only 0.0005 inch.

Universal Indicator: T. Daniel Bush, South Allentown, Pa. A universal indicator adapted for use on any type of machine where it is necessary to set the work up to conform to the requirements of a definite lay-out. The indicator consists of a piece holding an arm, which in turn holds the ball-headed indicator needle. The arm is secured to the base by means of a spring tension, adjusted by a knurled head-screw, and the tension on the ball head of the needle is controlled by a knurled head-screw on the arm.

Lubricant Pump: Hudson Pump Co., Inc., 17 Merseles St., Jersey City, N. J. A lubricant pump known as the "Little Niagara," which is especially adapted for use on machine tools. The pump is made in two sizes, Nos. 0 and 1, which have capacities for delivering 5¼ and 11 gallons per minute, respectively. The special feature of these pumps is that they are adapted for delivering a large volume of fluid when running at a slow speed, and that the mechanism is so designed that the pump is not likely to get out of order.

Threading Machine: Eastern Machine Screw Corporation, New Haven, Conn. A machine adapted for thread work which cannot be conveniently handled on an automatic screw machine. It is equipped with a self-opening die-head and spring collet or expanding arbors for holding the work. Work held in a collet is tightened by moving a lever at one end of the carriage, after which the work is fed to the die; and when the desired length of thread has been cut, the die-head automatically opens and the carriage is moved back by hand.

Thread-gage Grinding Machine: International Thread Gage Co., 100 W. 23rd St., New York City. A simple fixture which provides for grinding thread gages to correct distortion produced in hardening. This fixture is portable, so that it may be used on a table, bench, or in any other position which is found desirable. Power is furnished by an individual electric motor having a capacity of approximately 1/6 horsepower, this motor taking current from an ordinary electric light socket. Either male or female thread gages may be ground on this fixture.

Air Blowing Outfit: United States Air Compressor Co., Cleveland, Ohio. A two-stage portable air blowing outfit

adapted for blowing dust from motor or generator windings, soot from tubes of heater boilers, and various other services requiring high pressure air. A regulating valve permits the tank pressure of 150 to 200 pounds to be delivered at 10 to 60 pounds at the nozzle. With a tank pressure of 150 pounds and compressor operating continuously, air at 60 pounds can be delivered from the nozzle indefinitely. These machines are made in two sizes of 4 cubic feet and 10 cubic feet capacity, respectively.

Thread Grinding Machine: American Thread Grinding Machine Co., 814 Gates Ave., Brooklyn, N. Y. In designing this machine, a number of noteworthy departures have been made from established practice for the construction of grinding machines of this general type. Three grinding wheels are carried on the head, which is of the turret type, and these wheels are fastened by means of a stop at the front of the turret, the turret being clamped by a screw provided for that purpose. The use of three grinding wheels, makes it unnecessary to make the usual changes in set up when changing from rough to finish-grinding operations.

Portable Electric Drill: Black & Decker Mfg. Co., 10 Guilford Ave., Baltimore, Md. A 3/16-inch portable electric drill which is provided with the pistol grip and trigger switch which are a part of the standard construction of larger sizes of portable electric tools built by this company. With this form of control, the flow of electric current to the motor is controlled by pulling the trigger, without the necessity of the operator changing the position of the hand which is holding the drill. In addition to the 3/16-inch tool, a tool is made having a capacity for driving twist drills up to ¼ inch in diameter. Both are driven by an electric motor developing 1/6 horsepower.

Die Forming Machine: Anderson Die Machine Co., Iranistan Ave., near Admiral St., Bridgeport, Conn. In the February, 1917, number of MACHINERY a feed mechanism was described which had just been developed at that time for use on the Anderson die forming machine. Those who read the article will recall that the device provided means for conveniently guiding the die-block around the vertical rotating cutter. Recently, this company has placed on the market an equipment of practically the same design, except that it is provided with a pedestal base for setting up on the floor instead of mounting the tool on a bench, which was done in the case of the machine formerly described.

Conveyor: Buzz Engineering Co., Louisville, Ky. A conveyor used for carrying raw material and partially finished products through industrial plants at a uniform speed. The conveyor rollers are mounted on bearings, each of which is fitted with ten ¼-inch balls to reduce frictional resistance to a minimum, and both the cup and stud are casehardened and carefully ground to size. The roller bearings are designed with a special compression spring which stops rotation of the bearing and the roller carried by it, after the load has passed over the roller, although it does not retard the action at the time the bearing is under load. This prevents useless wear of the roller when it is not in use, and also eliminates noise caused through having idle rollers continue to rotate.

Cushion and Flexible Couplings: Three Rivers Machine Tool & Die Corporation, Phoenix, N. Y. This company has recently placed on the market the "Karge" cushion and flexible couplings. These devices consist of special alloy steel coils terminating in couplings by which the coils are fastened to the ends of steel shafting. Cushion couplings may be employed for connecting up lineshafts, or they may be used for connecting motor driving shafts of heavy-duty machines to serve as a buffer or cushion to reduce the starting strain on the motor. They also compensate for lack of accuracy in alignment. The flexible couplings are similar to the cushion couplings except that longer coils are used which permit a continuous line of shafting to be carried around corners or over obstructions.

Electric Drill: Arnold Electric Drill Co., New Haven, Conn. This company is now manufacturing a line of portable precision drills of two types. The drills have aluminum housings which enclose a driving motor that is of the Hamilton-Beach universal type of 110 to 220 voltage, 25 to 60 cycles. The Type A drill is 13 inches over-all, and when equipped with a Jacobs chuck, weighs 6 pounds. It has a capacity of ¼ inch in drilling steel. Type B is 15 inches over-all, weighs 8½ pounds, and has a capacity of ⅜ inch in steel and similar metals. The precision bench drill is of the sensitive type and has a handwheel control of the rack and pinion feed which is adjustable for wear. This type is also provided with a depth stop, and the tools are so attached to the vertical column that they may be set at any angle with the accurately machined bedplate.

Gap Bed Lathe: Willard Machine Tool Co., A St., Box 784 Cincinnati, Ohio. In the December, 1912, number of MACHINERY a description was published of the 13-inch Willard gap bed lathe which had just been placed on the market at that time. Recently, this firm has added to its line a 13- by 21-inch double back-geared semi-quick-change lathe with a gap bed. The design of this machine is similar to that previously described in MACHINERY, except for the semi-quick-change gear-box, which has a unit mechanism giving four positive feeds to the carriage. This number of feeds can be increased by shifting the gears in the change-gear box. All gears and clutches in the box are made of steel, and all running gears are bronze bushed. The lead-screw of the machine does not rotate while the lathe is engaged in the performance of turning operations. The regular feeds which are available are 0.006, 0.009, 0.013 and 0.021.

* * *

LABOR EMPLOYMENT CONDITIONS IN THE MACHINE TOOL INDUSTRY

The labor employment conditions in the machine tool trade vary widely. Many plants are still running full time and nearly full war-time force, but the majority have reduced the time to forty, forty-four, or forty-eight hours a week and run a force not exceeding 75 or 80 per cent of their war-time force, and some much less than this. In a couple of instances, manufacturers who reduced their hours and force have found business returning so rapidly to normal that they have returned to full hours and increased their force. One manufacturer is employing more men now than during the war period, because good men are now available, and they were not at that time. In unusual instances, a plant is even found to work over time in order to make deliveries, but this, of course, is an exception.

Wages are generally being maintained, and most manufacturers express themselves as favorable to keeping up present wages; but it is also stated that labor is now more efficient than during the war period, and that it is easier to obtain skilled and properly trained men so that the factories in general may be run on a more efficient basis. During the war period it was necessary to hire a great many wholly inexperienced men. As the pressure upon the plants is lessened, it is evident that these men are the first ones to be released, while the better trained men are kept. Hence, while wages are being maintained, efficiency is nevertheless increased and the conditions generally improved.

Many manufacturers are recognizing that the greatest problem confronting them is the labor problem. It is generally admitted that too much attention has been paid in the past to purely mechanical systems, and too little to the human element and to the question of handling labor in such a manner as to make it more efficient, and so that there can be real cooperation between employer and employe, thereby creating satisfaction and good feeling in place of strife and discontent.

* * *

THE FEDERAL LIQUIDATING ASSOCIATION

The Federal Liquidating Association has been formed to facilitate and hasten the liquidation of reduced, suspended, terminated, or cancelled war contracts. Brigadier-General Hugh S. Johnson will be president of the association. The officers of the association who share in the direction of the affairs are W. S. Symington, C. J. Symington, and H. H. Dinneen, representing manufacturers of war materials. The headquarters of the association will be in Washington, and bulletins of new rulings, procedure, etc., will be published promptly, and circulated among those interested. Local offices will also be established at each of the following points where there are local boards of adjustment: New York, Boston, Philadelphia, Baltimore, Rochester, Bridgeport, Pittsburg, Cleveland, Detroit, Cincinnati, Chicago, and St. Louis.

* * *

Thirty first-class boilermakers are urgently needed at the United States Navy Yard at Norfolk, Va. Permanent employment is assured. United States citizens only will be considered. A full apprenticeship and good physical condition are necessary. Application blanks can be secured from the Civil Service Commission, Washington, D. C.

Industrial Readjustment

Price Readjustment—Disposal of Aircraft Material—Trade with German Occupied Territory—Probable Future Trade with Poland—Sixth National Foreign Trade Convention

DEPARTMENT OF COMMERCE PRICE READJUSTMENT PLANS

THE Department of Commerce has proposed a plan to bring about the early resumption of American trade on a wholly normal basis, this plan having been especially recommended by William C. Redfield, Secretary of Commerce. Having received approval from the President of the plans proposed to readjust prices, an industrial board of the Department of Commerce has been formed, composed of representative men from industry, labor, and the Government, who are being selected under the chairmanship of George N. Peek, formerly vice-chairman of the War Industries Board and a well-known industrial leader and business man. This board expects to put into practical effect a program for the readjustment of prices for basic materials in such a manner as to create a firm foundation on which the consumer can base his future purchases and the producer his necessary estimates. In announcing the formation of the industrial board of the Department of Commerce, the Secretary of Commerce reviews the industrial conditions in a comprehensive manner, a summary of this review being presented below.

Causes of Present Business Conditions

Although commercial stocks are depleted; there is plenty of capital; building and construction work are several years behind the demands; a long period of enforced economy is relieved; and markets are in prospect in all parts of the world—it is still true that buying is timid and has decreased in volume; capital does not seek industrial investment; some mills and factories are idle and very few are running at full capacity; and non-employment, especially of unskilled labor, is spreading.

The war required the production of abnormally great quantities of certain commodities. This increase in production was secured by enormously increased prices of raw materials. Consequently, the sudden termination of the war left an inflated and irregular market. The price situation was originally created by the operation of the law of supply and demand, stimulated by the great need of the European countries for raw materials long before this country entered the war. Later, however, the law of supply and demand was replaced in many instances by governmental authority, export and import restrictions, and price fixing, so that the existing conditions may be said to have been brought about not by the normal operation of the law of supply and demand, but by the necessary agreements between government and industry.

The raw materials, the value of which increased abnormally on account of the demands of the war industries, must, in the opinion of the Department of Commerce, come down in price before there will be any general buying on the part of the manufacturers of machinery and other finished materials. However, while it is expected that prices of raw materials must fall, and while no one wants to buy until they do fall, even after price reductions have taken place, there will be a tendency to wait to see how far they will come down. Individual action in lowering selling prices on raw material is timid and long drawn out and does not render the market uniform or stable, but on the contrary renders it unstable and panicky.

Proposed Method for Stabilizing Prices

The Department of Commerce, therefore, proposes to cure the condition in the same way as it was caused. It was not caused by the normal operation of the law of supply and demand, but by general agreement between industry and government, and it must be cured by the same kind of cooperation and agreement. To this end, the President has authorized the industrial board to call the leading men of the industries together, group by group, and let them decide on the prices of raw materials to be offered to the nation, the price scale to be low enough to be stable and founded solidly on a comprehensive review of conditions, so that it will encourage general buying and the resumption of normal activities. Basic commodities such as steel, building materials, and textiles will be considered first and brought to a stable basis.

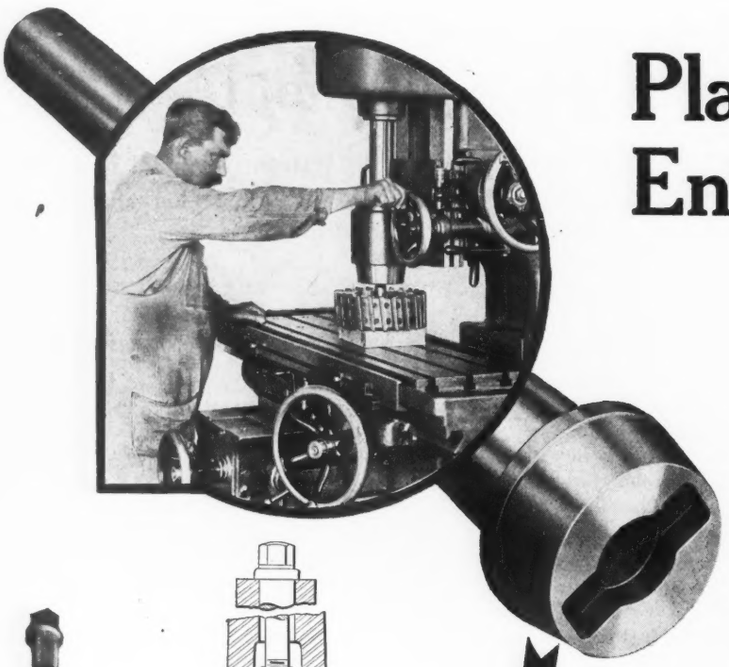
It is believed by the Department of Commerce that by bringing down the price of these staple raw materials, as well as the price of food, the cost of living may be so reduced as to create automatically reductions in the price of labor without interfering with the present standards of living conditions. It is believed that the industries will agree that the cost of living must be substantially reduced before labor should be asked to accept lower wages. From the stable level thus reached by cooperation, the Department of Commerce expects a healthy normal condition created by the complete and unhampered operation of the law of supply and demand.

The department recognizes that a general reduction in selling prices at this time will force industry and commerce to take a loss on products purchased at war prices, but considers this condition to be inevitable whether the proposed plan is attempted or not. Under the proposed plan, however, better adjustments are considered possible, because it is believed that buying will begin immediately, that the overhead of continuing high-cost operation in a period of stagnation will be eliminated, and that much of the loss will be retrieved by buying at fair prices and selling in the inevitably increasing market that will result. In conclusion, it is stated by the department that it is expected that the activities of the new board will be temporary only. The offices of the board are in the Council of National Defense Building, 18th and D Sts., Washington, D. C.

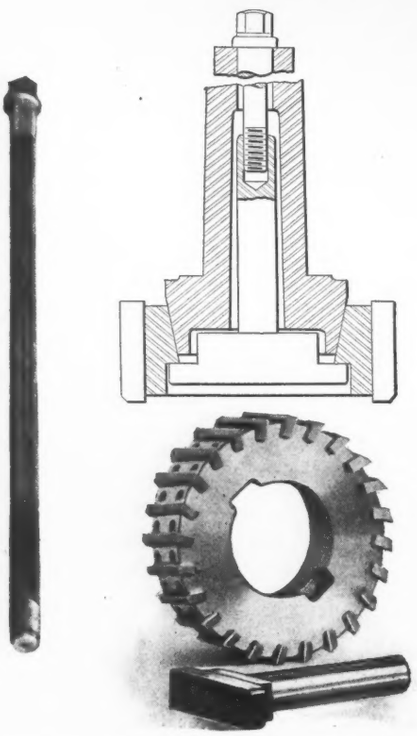
* * *

DISPOSAL OF MATERIAL IN THE HANDS OF BUREAU OF AIRCRAFT PRODUCTION

Plans for the disposal of surplus material now in the possession of the Bureau of Aircraft Production, or which is being taken over by this bureau upon settlement of contracts with manufacturers, have been completed, and the organization for carrying out the details is rapidly being perfected. The primary consideration in these plans, which have been matured under the general policies as laid down by the Director of Sales of the War Department, has been



Place Cutter on Enters Cutter, *Simple,*



Only a Drawing-in Bolt and Cutter Driver Required to Hold and Drive Face Milling Cutters

on Brown & Sharpe Milling Machines because of the taper-nose construction of the spindle. Method of attaching cutter is a time-saving feature on all types and especially advantageous on the vertical spindle machine. See diagram and description at left.

Nose of Spindle Free From Projecting Parts

No Screws, Plates or Loose Parts

Cutter driver fits slot in cutter and recess in end of spindle and is held in place by drawing-in bolt (see diagram and illustrations above). When in place cutter driver serves as a clutch and assures a positive drive.

REPRESENTATIVES IN U. S. A.

BALTIMORE, MD., Carey Machinery & Supply Co.
CINCINNATI, O., INDIANAPOLIS, IND., The E. A. Kinsey Co.
SAN FRANCISCO, CAL., Pacific Tool & Supply Co.
CLEVELAND, O., DETROIT, MICH., Strong, Carlisle & Hammond Co.
ST. LOUIS, MO., Colcord-Wright Machinery & Supply Co.
SEATTLE, WASH., Perine Machinery Co.
PORTLAND, ORE., Portland Machinery Co.

Brown & Sharpe

PROVIDENCE,

OFFICES: CHICAGO, ILL., 626-630 Washington Blvd.
PHILADELPHIA, PA., 1103-1105 Liberty Bldg.
PITTSBURGH, PA., 2538 Henry W. Oliver Building.

Brown & Sharpe of New York, Inc.

OFFICES: NEW YORK CITY, 20 Vesey St.
ROCHESTER, 415 Chamber of Commerce Bldg.
SYRACUSE, Room 419 University Block.

Table, Lower Spindle Until Nose Fasten With Drawing-in Bolt—

Isn't It?

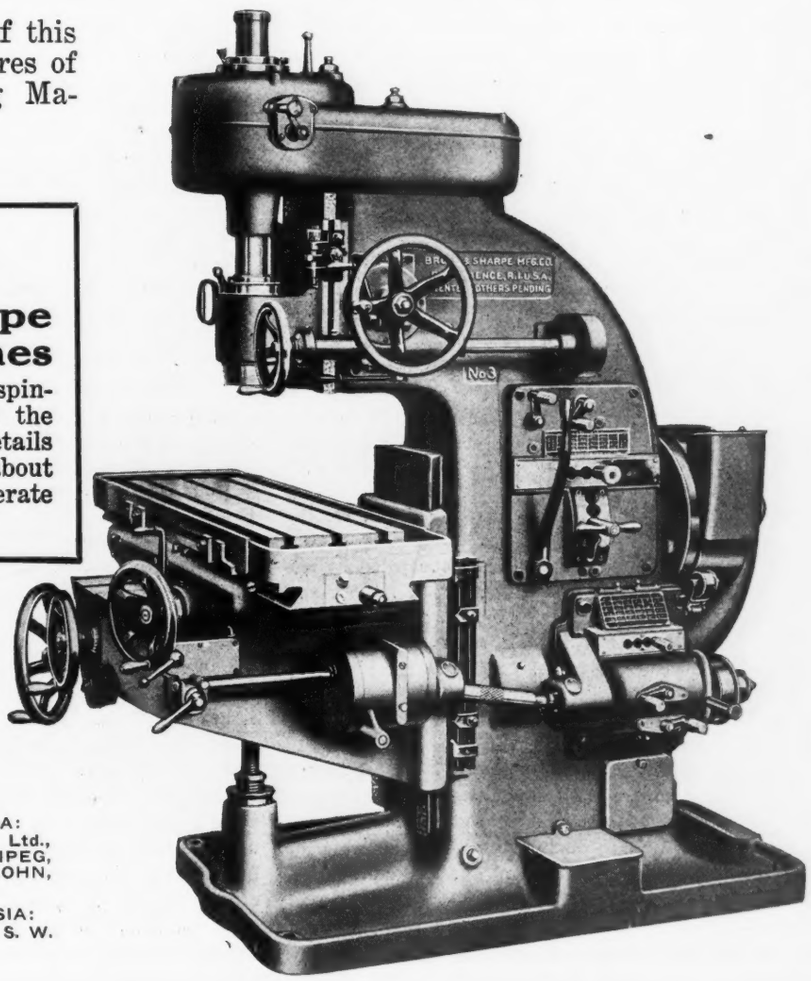
—and it is just as simple as it sounds to put a face milling cutter of any size on

BROWN & SHARPE VERTICAL SPINDLE MILLING MACHINES

because of the taper-nose construction of the spindle.

Let us tell you in detail of this and the many other features of Brown & Sharpe Milling Machines.

Send Today
For New Book on
Brown & Sharpe Milling Machines
explaining the taper-nose spindle feature in detail and the many other interesting details which you should know about these productive, easy-to-operate milling machines.



Mfg. Co.
R. I., U. S. A.

REPRESENTATIVES IN CANADA:
Canadian Fairbanks - Morse Co., Ltd., TORONTO, MONTREAL, WINNIPEG, CALGARY, VANCOUVER, ST. JOHN, SASKATOON.

REPRESENTATIVE IN AUSTRALASIA:
R. L. Scrutton & Co., Ltd., Sydney, N. S. W.

the prevention of any disruption of the market and as full and complete protection of the nation's industries as possible, as the following outline will show.

There has been formed a Material Disposal Section of the Bureau of Aircraft Production, organized on a basis similar to that followed by large commercial houses which handle sales through branch offices. This section will be under the direction of Lieutenant Charles S. Shotwell. Sales will be made under the supervision of a sales manager stationed at Washington. The Bureau of Aircraft Production will probably have for sale the following classes of material, and as soon as this material has been established as surplus and a policy for the sale determined, the bureau will issue bulletins covering the material for sale: Machine tools and fixtures; electrical machinery; dies, tools, jigs, and gages; chemicals, paints, and oils; metals, motor accessories; lumber; hardware; buildings and lands; fabrics; scrap; shop equipment; office equipment; and miscellaneous.

Sales negotiations will be handled by salesmen in each of eight district branches, to be located in Boston, Buffalo, Chicago, Dayton, Detroit, New York, Pittsburg, and San Francisco. These salesmen will be authorized to make sales of property wherever located, after it has been cleared by the Board of Sales Review of the office of the Director of Sales, so that the prospective buyers will communicate with the branch office in the city located nearest them. This arrangement, it is expected, will make it possible for manufacturers needing machinery and supplies to purchase conveniently and at fair prices. The salesmen will have full authority to sell at the best offer made, provided that offer is at or above an appraised value arrived at independently, or at market value in the case of raw material.

Bulletins containing full descriptions of material for sale will be issued from time to time, and will be kept thoroughly up to date. Those interested will be placed on the mailing list upon request addressed to the Bureau of Aircraft Production, Material Disposal Section, Washington, D. C. To save delay, requests should specify the commodities on which information is desired, in accordance with the list of materials given above.

* * *

FOREIGN TRADE NOTES

The War Trade Board has announced, for the information of exporters in the United States, that all commodities may now be imported freely into Belgium, except some classes of foodstuffs, luxuries, and coal, which still require Belgian import license; hence, machinery and metal products may be shipped without Belgian import license. The War Trade Board has also announced that all persons in the United States are authorized, subject to the rules and regulations of the War Trade Board, to trade and communicate with persons in Bulgaria and in the Turkish Empire, both in Europe and in Asia Minor. All Roumanian ports on the Black Sea are now open for trade with the United States, and accordingly applications will now be considered by the War Trade Board for licenses to export or to import any products to or from Roumania.

The War Trade Board has further announced that the French import restrictions have been removed from a large number of industrial products including machinery for paper manufacture, machinery for the printing and publishing trades in general, and refrigerating machinery.

Trade with Occupied Territory of Germany, German Colonies, and Luxemburg

Trade has been resumed with that part of the Rhine provinces of Germany which is included within the area of military occupation by the American and Allied armies. Information may be obtained from the War Trade Board as to the methods by which exports to and imports from such territory will be governed. It has also been announced that all persons in the United States are authorized, subject to the rules and regulations of the War Trade Board, to trade and communicate with persons residing in the colonies belonging to Germany previous to the war. Accordingly, applications will now be considered for licenses to export or import commodities to or from these colonies. For importations into the United States from these colonies, individual import licenses will be required. The War Trade Board has received no official advice as to the import regulations into the colonies. Hence exporters should communicate with their customers abroad before making shipments, in order that the importer may comply with any regulations that may be in effect in the territory referred to.

In order to remove any uncertainty with regard to trade relations between the United States and Luxemburg, the War Trade Board has announced that all persons in the United States are authorized to trade and communicate with persons residing in Luxemburg, subject to the rules and regulations of the War Trade Board.

Probable Future Trade with Poland

The Commercial and Industrial Bureau of the Polish National Department, established in the Aeolian Building, 32 W. 42nd St., New York City, endeavors to furnish American manufacturers and exporters with detailed information relative to the needs of Poland, and expects to arrange for loans and credits to meet the tremendous purchases of both raw materials and manufactured products that are expected. Previous to the outbreak of the war, Poland's annual industrial output was valued at $1,000,000,000, and her industries employed 900,000 men. It is stated that these industries, including large factories for textile, metal, and paper manufacture, have been practically denuded of their machinery by the Germans, and that there is now an immediate necessity for machinery of every kind, and especially for textile and mining machinery.

Plans have already been made for developing and enlarging the railway system of Poland, especially in that portion of the country that was formerly Russian territory. While there are nearly 16 miles of railway per 100 square miles in former Prussian Poland, and over 8 miles per 100 square miles in former Austrian Poland, yet there are only 4 miles per 100 square miles in former Russian Poland. The plans call for a first group of railways to be constructed of over 1100 miles, and for a second group of over 800 miles, which will require a total of 260,000 tons of rails in addition to other supplies and equipment. The immediate requirements for rolling stock call for 1400 locomotives, 40,000 freight cars, and 1100 passenger cars, while the equipment for the new lines would require about 1200 locomotives, 33,000 freight cars, and over 1000 passenger cars.

It is stated that the question of providing Poland with rolling stock is extremely important, because there is danger that if the country is not supplied by the Allied nations, Germany may be able to carry out her plan of supplying Poland with materials and rolling stock, and would thereby acquire a control over the Polish railways that would be extremely objectionable.

Sixth National Foreign Trade Convention

"Foreign Trade Essential to American Industry" will be the theme of the Sixth National Foreign Trade Convention which will meet at the Congress Hotel, Chicago, Ill., on Thursday, Friday, and Saturday, April 24, 25, and 26. Part of the time of the convention will be devoted to the presentation of papers by men who are directing the chief industries of the nation, but the greater part of the time will be devoted to discussions of practical problems in group sessions under the direction of qualified experts, and in personal conferences with experienced trade advisors and representatives of government departments dealing with foreign trade. The office of the National Foreign Trade Council is at India House, 1 Hanover Square, New York City, and James A. Farrell, president of the United States Steel Corporation, is the chairman of the council.

This is Accurate Milling

It is milling crank-case surfaces 6⅜″ x 24″ at a 90° angle in two settings. The work is done on a Cincinnati No. 3 Vertical Milling Machine, with a 9″ diameter cutter, operating at 180 R. P. M., or 424 feet per minute, and at a feed of 12½″ per minute, including both longitudinal and transverse feed.

Error is kept within the 0.0015″ limit allowed for both surfaces.

Two "No. 3's" are on this job. Average production from each machine, each operation, 100 crank-cases in 10 hours, and the work as difficult as you can find.

"Cincinnati" milling helps make the Cadillac Motor the accurate motor it is. It will prove equally efficient for your work. Ask us to show you.

The Cincinnati No. 3 Vertical Milling Machine

Send us blueprints or samples and let us estimate production on your work.

THE CINCINNATI MILLING MACHINE CO.

CINCINNATI, OHIO, U. S. A.

A NEW BOOK ON THREAD-CUTTING

THREAD-CUTTING METHODS. By Franklin D. Jones. 344 pages, 6 by 9 inches. 211 illustrations. Published by THE INDUSTRIAL PRESS, 140-148 Lafayette St., New York City. Price, $2.50.

A work dealing exclusively with thread-cutting methods, describing in detail the processes used for producing screw threads and the machines and devices employed in general machine shop practice for this purpose, has long been needed. While the subject of thread cutting has been dealt with briefly in all the general books on machine shop practice, there has never been published a comprehensive and modern work on the subject, and the present book, therefore, aims to meet this need.

The universal use of screw threads has led to the development of many different kinds of tools and machines for cutting or forming them. These tools vary from the hand-operated tap or die to the specialized semi-automatic and fully-automatic machines, and the purpose of this treatise is not only to describe the important types of tools, machines, and methods which have been developed for producing external and internal screw threads, but also to show the relation between the different processes. If the screw thread problem were merely to determine how to cut a thread of the required size, pitch, and accuracy, it would, in most cases, be relatively simple, but like other manufacturing problems, it is usually complicated by the fact that the work must be done on a commercial basis.

The various methods of forming screw threads are familiar to practically all machinists and machine shop foremen, but comparatively few know to what general class of work each method is best adapted. While it is often difficult to decide this question, an understanding of the reasons why different types of threading tools and machines were originated and the kind of work for which they are generally used will at least simplify the problem greatly. A special effort has been made to include in this book all the information possible pertaining either to the adaptability of various types of tools and machines or to their relative merits as applied to different classes of work.

In addition, the book deals with different standard forms of screw threads; general thread-cutting practice in engine lathes or other machines using a single-point tool; special auxiliary thread-cutting mechanisms and attachments applied to engine lathes or other machines; design, operation, and application of various classes of threading dies and taps; standard and special threading machines; tapping machines and attachments; the causes of defective and inaccurate screw threads; thread milling machines and their use; and the production of screw threads by the rolling process.

* * *

CORRECTION

On page 605 of the March number of MACHINERY, in the article entitled "Tensile Tests of Cast Iron and Semi-steel," the statement is made in the last paragraph that "the only accurate machining that is necessary is on the central portion, which is made one inch square." This sentence should read: "The only accurate machining necessary is on the central portion, which is made one square inch in area."

PERSONALS

F. J. SCHWARB, formerly of Beals & Co. and the Cygnet Mfg. Co., is now associated with the Aborn Steel Co. at Buffalo, N. Y.

GRANT J. WOOLSTON, formerly of the Fulton Steel Corporation, is now associated with the Aborn Steel Co., 22 Clarke St., New York City.

C. H. BREAKER has been appointed assistant sales manager for the Diamond Chain & Mfg. Co., Indianapolis, Ind., in charge of sales promotion.

THOMAS PRICE, who was with the Midvale Steel Co. for over twenty years, is now associated with the Aborn Steel Co., Inc., at 22 Clarke St., New York City.

W. L. ROMAINE, who has been secretary and manager of the machine tool department of the Badger-Packard Machinery Co., Milwaukee, Wis., is no longer associated with the company.

GEORGE KOMOROWSKI, an engineer now at Ugine, Savoie, France, would like to correspond with American makers of machinery, factory supplies, and hardware for shipment to Poland under an exclusive sales agency agreement.

MORRIS L. COOKE, H. K. HATHAWAY, BOYD FISHER, KEPPELE HALL, and JOHN H. WILLIAMS announce that they have opened an office as consulting engineers in management in the Finance Bldg., South Penn Square, Philadelphia, Pa.

WILLARD B. JACKSON, who has been Boston district manager for William Jessop & Sons, Inc., for a number of years, is now connected with the Simonds Mfg. Co.'s steel mill that is located at Lockport, N. Y. Mr. Jackson has opened a New England office for the Simonds steel mill at 120 Milk St., Boston, Mass.

C. W. JOHNSON has been appointed assistant manager of works of the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa. Mr. Johnson entered the employ of the company in 1907 as chief inspector of works, and was later promoted to the position of general superintendent, in which capacity he served until his recent appointment.

EDWARD S. DAVIS, who has been in the service of the Government as chief of the Fuel Oil Section, Bureau of Oil Conservation, United States Fuel Administration, has returned to Tate-Jones & Co., Inc., Pittsburg, Pa., and will act as district manager, directing sales and service in the Chicago district with offices at 931 Monadnock Bldg., Chicago, Ill.

J. F. MACKIN has recently become connected with the Black & Decker Mfg. Co., Baltimore, Md., and is representing the company throughout the entire state of Ohio, with headquarters at Columbus, Ohio. Mr. Mackin has been connected with the portable electric drill industry for years. He was formerly associated with the Independent Pneumatic Tool Co.

GEORGE E. HARRIS, for the past year first lieutenant in the United States Army assigned to the Bureau of Aircraft Production, Finance Department, is now connected with the Hawkridge Bros. Co., 303 Congress St., Boston, Mass., as director of sales. Mr. Harris has been well known to the steel trade for the past twenty years in both the operating and selling departments.

CHARLES W. UNBEHAUN, formerly New York City and general eastern salesman for the Bailey-Drake Co., Chicago, Ill., is now branch manager of the Black & Decker Mfg. Co., Baltimore, Md., manufacturer of portable electric drills, "Lectroflater" electric air compressors, and electric valve grinders. Mr. Unbehaun's district will cover eastern New York and the state of Connecticut.

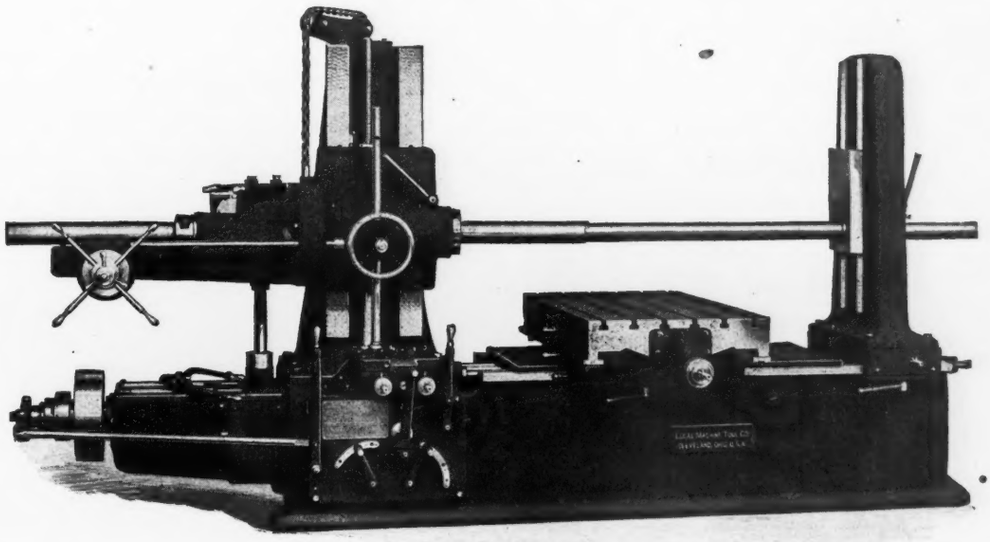
J. T. PLUMMER, who has been connected with the Haynes Stellite Co., as district manager, for the past two and a half years, at Cleveland, Ohio, and at Kokomo, Ind., has resigned to open sales offices in Chicago for "Perfect" pulley coverings—a special fabric, manufactured by the Kingsley Mfg. Co., of Indianapolis, Ind., which is attached to all kinds of pulleys by a patented adhesive, to eliminate the slipping of belts.

G. WILLIAM CRISPELL has been appointed production superintendent of the Electric Service Supplies Co., Philadelphia, Pa. Mr. Crispell received his early training with the General Electric Co., spending several years on installation and maintenance work, and was for several years in charge of the electrical manufacturing of the Consolidated Car Heating Co. Before assuming his present position, he was assistant superintendent of the Westinghouse Electric Products Co. at Mansfield, Ohio.

W. H. DIEFENDORF, since October 20, 1889, chief engineer for the New Process Rawhide Co. and its successor, the New Process Gear Corporation, and also a director in those corporations, has become vice-president and general manager of the Weekes-Hoffman Co., Syracuse, N. Y., which has recently been organized to manufacture automobile and tractor gears. Mr. Diefendorf is an expert on the manufacture of automobile and other machine gears and brings to the new concern the benefit of his long experience.

EDWARD N. HAY, who has recently been discharged, upon his return from overseas, from his commission of Captain of Ordnance, has joined the Robert T. Pollock Co., 68 Devonshire St., Boston, Mass. Mr. Hay has made a comprehensive study of the latest manufacturing processes and methods of organization of some of the best known concerns in France, England, and Scotland during the course of his work on tanks for the Ordnance Department, and the experience thus gained, in addition to his previous training, especially fits him for undertaking cost, engineering, and production work.

CAPTAIN GEORGE SYKES, who has been in this country nearly four years attached to the British War Mission in a commercial capacity, sails for Europe in May. He has joined the Dutilh-Smith McMillan Co. as London manager of the engineering and railroad departments. For many years prior to the war, Captain Sykes was connected with electrical manufacturers in the sales and engineering departments of power and traction corporations. He will be glad to hear from firms wishing to introduce high-class products in Europe—electrical and mechanical specialties for use in power and traction corporations, mining, aeronautical, steel, automobile, electrical, machine tool, shipbuilding and cement industries. His New York address is 50 Broad St., and his London office is Central Bldgs., Totehill St., Westminster.



"The open eye of the open mind" needs no glass to see that the

"PRECISION"

Boring, Drilling and Milling Machine

Is the nearest approximation to perfection in the selection of details important in machine design.

These details are given as far as possible in a circular which we would like you to send for.

LUCAS MACHINE TOOL COMPANY

NOW AND ALWAYS OF

CLEVELAND, OHIO, U. S. A.

GENERAL GUY E. TRIPP who, before entering the government service during the war, was president of the Board of Directors of the Westinghouse Electric & Mfg. Co., to which position he returned after the signing of the armistice and the cessation of hostilities, was recently decorated by the United States Government with the distinguished war service medal, which was awarded him for his work in systematizing methods and practice in the Ordnance Department, resulting in a thorough cooperation between the industries producing ordnance material for the Army. It was General Tripp who conceived the idea that the production work of the Ordnance Department should be handled from different points throughout the United States instead of from one big office in Washington. This scheme was highly satisfactory, and was one of the means of speedy and efficient production.

COMING EVENTS

April 7-9—Joint convention of the American Supply & Machinery Manufacturer's Association and the Southern Supply & Machinery Dealers' Association, at New Orleans, La.

April 9—Monthly meeting of the New England Foundrymen's Association, at Boston, Mass. Secretary, Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

April 14-16—Annual convention of the American Gear Manufacturers' Association, at Cleveland, Ohio. Secretary, F. D. Hamlin, of the Earle Gear & Machine Co., 4705 Stenton Ave., Philadelphia, Pa.

April 21-24—Convention of the National Metal Trades Association at New York City; Hotel Astor, headquarters. Secretary, Homer D. Sayre, Peoples Gas Bldg., Chicago, Ill.

April 24—Monthly meeting of the Rochester Society of Technical Draftsmen, in Rooms 131-137 Sibley Block, 328 Main St., E., Rochester, N. Y. Secretary, O. L. Angevine, Jr., 857 Genesee St., Rochester, N. Y.

April 24-26—Sixth National Foreign Trade Convention, at Chicago, Ill. Secretary, O. K. Davis, 1 Hanover Square, New York City.

May 12-13—Spring convention of the National Machine Tool Builders' Association at Atlantic City, N. J.; headquarters, Hotel Traymore. General manager, Charles E. Hildreth, care of Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.

June 17-20—Semi-annual convention of the American Society of Mechanical Engineers, at Detroit, Mich. Secretary, Calvin W. Rice, 29 W. 39th St., New York City.

June 19-21—Joint convention of the American Drop Forge Association and the Drop Forge Supply Association, at Pittsburg, Pa., in the Chamber of Commerce Building. Secretary, Arthur W. Peterson, 108 Smithfield St., Pittsburg, Pa.

September 29-October 4—Eighth annual congress of the National Safety Council at Cleveland, Ohio.

SOCIETIES, SCHOOLS AND COLLEGES

University of Nebraska, Lincoln, Neb. Forty-eighth annual general catalogue, containing the complete record for 1917-1918 with announcements for 1918-1919.

Beloit College, Beloit, Wis. Seventy-second annual catalogue for the year 1918-1919 containing calendar, courses of study, and general information concerning the college.

Stevens Institute of Technology, Hoboken, N. J. Annual catalogue for 1919, containing calendar for 1919-1920, courses of study, and general information concerning the institute.

Polytechnic Institute of Brooklyn, 85 Livingston St., Brooklyn, N. Y. Bulletin for March 1919 containing the calendar and information concerning the courses offered by the institute.

BOOKS AND PAMPHLETS

Manual of Inspection and Information for Weights and Measures Officials. By F. S. Holbrook, inspector of weights and measures, Bureau of Standards. 246 pages, 4¾ by 6¾ inches. Published by the Department of Commerce, Washington, D. C., as Miscellaneous Publication No. 1 of the Bureau of Standards.

Tables and Other Data for Engineers and Business Men. Compiled by Charles E. Ferris. 230 pages, 2¾ by 5¼ inches. Published by the University of Tennessee, Knoxville, Tenn. Price, 50 cents.

This is the twenty-second edition of a well-known manual for engineers, published by the University of Tennessee. The object in compiling the book has been to secure a medium whereby the strongest possible arguments in favor of technical education as a means of developing the resources of the South may be brought before the minds of the men who control the affairs of that part of the country. In preparing the book, the compiler, who is professor of mechanical engineering at the University of Tennessee, has drawn freely on other handbooks, manufacturers' catalogues, and publications issued by the professors of the university, and many other sources.

Model Making. By Raymond F. Yates. 390 pages, 5¾ by 8¾ inches. 303 illustrations. Published by Norman W. Henley Publishing Co., 2 W. 45th St., New York City. Price, $3.

This book is a practical treatise for the amateur as well as the professional mechanic, giving instructions on the various processes and operations involved in model making, and showing examples of the actual construction of various kinds of models, including steam engines, speed boats, guns, locomotives, and cranes. It also includes hints on shop practice, lathe work, pattern work, electroplating, soft and hard soldering, grinding, drilling, etc. The chapter headings give a good indication of the general scope of the work: The Model Engineers' Work-shop; Lathes and Lathe Work; Drills and Drilling; Soft and Hard Soldering; Hardening and Tempering Steel; The Use of Abrasives; Patternmaking; Electroplating; A Model Slide Crank Steam Engine; A Model Twin-cylinder Engine; A Single-cylinder Engine; A Model Twin-cylinder Marine Engine; Flash Steam Plants; A Flash Steam Plant for Large Model Airplanes; A Flash Steam Plant for Small Model Airplanes; A Model Steam Turbine; Design and Construction of Model Boilers; Model Boiler Fittings; A Record-breaking Model Hydroplane; A Model Lake Freighter; A Sharpie-type Model Boat; A Model Submarine Chaser; A Model Submarine with Radio Control; A Model Crane; An Electric Double-drum Hoist; a Model Gasoline Engine; A Model Electric Locomotive; A Model Steam Locomotive; A Model Gyroscope Railroad; A Model Caterpiller Tank; A Model Siege Gun.

Steam Engine Troubles. By H. Hamkens. 284 pages, 5 by 7½ inches. 276 illustrations. Published by Norman W. Henley Publishing Co., 2 W. 45th St., New York City. Price, $2.50.

This is a practical treatise intended for the engineer of a stationary or marine engine plant, dealing with methods of locating and remedying trouble in a steam engine. The author has had considerable experience for a number of years with steam engines, both small and large, as designer and superintendent of erection. During this experience, he has found that the troubles encountered in the operation of a steam engine plant form a large part of the work of an engineer. The development and perfection of the steam engine has limited the number of breakdowns and serious repairs, so that the engines are more reliable, but, on the other hand, the constant improving and changing has added so great a number of differently arranged parts that it is almost impossible for the practical man, whose time is limited and who has not the opportunity to come into personal contact with the new features that have been introduced, to keep thoroughly informed upon them all. This book is, therefore, intended to supply the information that the practical engineer requires. The contents of the book are best illustrated by a review of the twenty chapter headings, which are as follows: Cylinders; Valves; Piping and Separators; Throttle and Emergency Valves; Pistons; Frames; Bearings; Connecting-rods; Hook Rods; Dashpots; Governors; Releasing Gears; Wrist-plates and Valve Motions; Rod Ends and Bonnets; Oilers; Receivers; Foundations; Erecting; Valve Setting for Corliss Engines; Operation.

NEW CATALOGUES AND CIRCULARS

Baldwin Locomotive Works, Philadelphia, Pa. Record No. 92, describing the fifty-thousandth locomotive constructed by this company.

Griscom-Russell Co., 90 West St., New York City. Bulletin 609, describing the Reilly multi-screen feed water filter and grease extractor.

Gisholt Machine Co., Madison, Wis. Circular advertising the Gisholt turret lathe book, which has recently been brought out by this company.

Gwilliam Co., 253 W. 58th St., New York City. Catalogue giving dimensions, weight, and other specifications for ball and roller bearings of various types.

Independent Pneumatic Tool Co., Chicago, Ill. Circular 30, descriptive of the "Thor" line of pneumatic drills, hammers, sand rammers, holders-on, and hoists.

Walter A. Zelnicker Supply Co., St. Louis, Mo. Bulletins 260 and 261, containing lists of new and used steel sheet piling, rails, cars and trucks, bridges, generator set, and pipe.

Quigley Furnace Specialties Co., Inc., 26 Cortlandt St., New York City. Bulletin 11, describing and illustrating the equipment employed in the Quigley system for preparing, distributing, and burning powdered fuels.

J. E. Snyder & Son, Worcester, Mass. Catalogue illustrating and describing Snyder upright drilling and tapping machines made in 23-, 25-, 28-, 30-, 36-, and 46-inch sizes. These machines are made both with stationary and with sliding heads.

Morse Chain Co., Ithaca, N. Y. Catalogue 16 entitled "A Chain of Evidence," treating of small power drives and containing a large number of illustrations showing Morse silent chain in use in various shops for different classes of drives.

Ransome Concrete Machinery Co., Dunellen, N. J. Catalogue 200, containing fifty pages of matter relating to concrete chutes and equipment, and showing a wide variety of equipment and applications. Copies will be sent free upon request.

Air Reduction Sales Co., 120 Broadway, New York City. Folders of "Airco" welding and cutting apparatus, acetylene generators, welding rods, etc., describing methods of building up worn frogs and repairing damaged locomotive cylinders.

Rochester Ball Bearing Co., Inc., 205 State St., Rochester, N. Y. Catalogue 12 giving dimensions and prices of the Rochester standard ball thrust bearings. The company is also especially equipped to make special thrust bearings in any material or size.

Genesee Mfg. Co., Rochester, N. Y. Circular descriptive of the Genesee adjustable hollow-mill, made in two types, for cutting brass and steel. The tool can be adjusted to 125 different sizes, and is adapted for a cutting speed of 12 to 15 inches per minute on steel.

Oliver Instrument Co., Adrian, Mich. Catalogue describing the Oliver sawing, filing, and lapping machine—a precision machine for use in die-making, instrument-making, experimental work, and for general manufacturing purposes, for sawing, filing, and lapping straight or irregular surfaces.

Oesterlein Machine Co., Cincinnati, Ohio. A booklet entitled "The Oesterlein Story," containing a detailed description of the "Ohio" plain and universal milling machines. The booklet also contains tables of specifications for the Nos. 20, 24, 28, 34, and 42 plain and universal milling machines.

Ingersoll-Rand Co., 11 Broadway, New York City. Form 9026 treating of Ingersoll-Rand high-speed piston valve steam engine, class FP of the horizontal center crank type; Form 9120 descriptive of the Leyner oil furnace; and Form 9123 illustrating and describing "Imperial" tie tamping outfits.

Swedish Gage Co., Inc., 245 W. 55th St., New York City. Pamphlet entitled "The Story of Johansson and His Mysterious Gages," containing a historical sketch of C. E. Johansson, the inventor of the Johansson gages, and a description of the development of the Johansson system of gaging, which is accurate to 0.00001 inch.

Gisholt Machine Co., Madison, Wis. Booklet entitled "The Missing Link," telling how an accurate record of the time actually spent in producing, and the loss of time through breakdowns or other causes of delays can be obtained by the use of the periodograph. The booklet reproduces typical charts made with this instrument.

Hercules Electric Steel Corporation, 137 Lafayette St., New York City. Catalogue containing a detailed description of the properties, manufacture, treatment, and uses of "Urite" high-speed steel. The booklet includes reports of tests made with "Urite" high-speed steel tools on various materials, with different speeds and feeds.

Erie Foundry Co., Erie, Pa. Catalogue F of Erie steam forging hammers, steam drop-hammers, trimming presses, and sheet galvanizing and shearing machinery, giving dimensions, capacity, and other specifications. The book also contains instructions for erecting, operating and adjusting Erie single- and double-frame steam hammers, and steam drop-hammers.

Smalley-General Co., Inc., Bay City, Mich. Folder illustrating and describing the Smalley-General No. 2 universal and chucking hollow-spindle thread miller, which has a capacity for 9 inches outside diameter and 13 inches inside diameter threads with a 2-inch diameter hob, and will mill either internal or external, right- or left-hand, straight or tapered threads.

Hyatt Roller Bearing Co., Metropolitan Tower, New York City. Engineering bulletin 420, giving complete designs for the application of Hyatt roller bearings to machine tools of all kinds at the various bearing points on the machines. The bulletin also contains a complete load and speed table which gives the safe load of Hyatt roller bearings for all dimensions and all classes of machine tools.

FILES
DRILLS
TAPS and DIES
MACHINISTS TOOLS
BOLTS and SCREWS
FACTORY SUPPLIES
Etc., Etc.

In this period of reconstruction it is more important than ever to keep up the stock in your store-room—have the gaps filled in and levelled off—to be prepared to better meet the new conditions as they develop and the competition which is sure to come.

We are ready for you with a large and assorted line of

General Hardware, Tools and Factory Supplies

and solicit an opportunity to figure on your requirements.

HAMMACHER, SCHLEMMER & CO.

HARDWARE, TOOLS AND FACTORY SUPPLIES

NEW YORK, SINCE 1848 **4th Avenue and 13th Street**

Newton Machine Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa. Catalogue 49A of Newton slotting machines and upright generating planers. Insert pages, printed in color, illustrate cold saw cutting-off machines, locomotive link grinding machines, horizontal milling machines, vertical milling machines, rotary planers, keyseat milling machines, and duplex locomotive rod boring machines.

Landis Machine Co., Waynesboro, Pa. Catalogue 25, illustrating and describing in detail Landis stationary pipe die-heads, pipe threading and cutting machines, rotary pipe and nipple threading die-heads, pipe and nipple threading machines, and the Landis chaser grinder. Specifications are given for the various sizes of machines, as well as tables of clearances for the die-heads. Copies of this catalogue will be sent upon request.

Whitman & Barnes Mfg. Co., Akron, Ohio. Catalogue 91, covering all the products of this company in the machinists' supply line, including carbon and high-speed steel twist drills and reamers, screw and drop-forged wrenches, spring cotters and keys. The book is provided with a thumb-index which makes it convenient to refer to any particular section. One section contains tables giving information of general interest to users of these tools.

James Archdale & Co., Ltd., Ledsam St., Birmingham, England. Catalogue of high-speed drilling machines of the radial and vertical types, giving full dimensions of the various sizes and information concerning the construction, accessories, etc. Catalogue of high-speed vertical and horizontal milling machines, made in sizes up to 30 inches traverse of table. The catalogue illustrates the different types, and gives specifications for each, as well as for the accessories and cutters used with this line of machines.

Federal Machine & Welder Co., Dana Avenue, Warren, Ohio. Bulletin 31, illustrating and describing electric butt-welding machines; bulletin 32, describing the "Junior" type spot-welding machines; and bulletin 33, describing the "Universal" spot-welding machines. The last-named machines are equipped with "Universal" welding points which can be placed vertically, extending straight forward, swiveled sideways, or held at an angle of 30 degrees so as to permit welding under a projecting ledge or overhanging part.

Precision Castings Co., Inc., Syracuse, N. Y. Handbook on die-castings, giving complete information concerning dies and casting processes, metals, methods of fabrication, finishing, etc. The book also contains tables giving data of use in connection with die-casting processes. Among the subjects treated are the following: Advantages of using die-castings; metals; dies, die design and construction; die-casting design; accuracy; inserts; die-casting processes; machining die-castings; electroplating die-castings; soldering die-castings, etc.

Westinghouse Electric & Mfg. Co., East Pittsburg, Pa. Complete catalogue made up of 1264 pages in which all the electrical supplies of the Westinghouse company are listed. Although the book is called a catalogue, it contains a great deal of information of a technical and engineering nature, and practical suggestions for the use of many kinds of electrical apparatus and for the transmission and utilization of electrical power are given. It is planned to issue this catalogue annually. The value of the catalogue is considerably enhanced by a complete cross-index, which makes it possible to locate readily any devices or machines required, and also by a table of "Approximate Cost Multipliers," which facilitates the calculation of the approximate cost of all supplies listed.

Oliver Machinery Co., Grand Rapids, Mich. Catalogue entitled "Universal Wood Milling Machine," describing the Oliver No. 102 universal wood milling machine, especially designed for the pattern shop of large engineering plants, railroads, shipyards, arsenals, and all manufacturers using wood and metal. It is claimed that this machine is to the patternmaker and his department, what the universal milling machine, shaper, and drilling machine is to the metal worker and the machine shop. Both wood and soft metal patterns can be worked out on this machine. The book gives complete information concerning the construction and operation, and contains many illustrations of the machine engaged in various classes of work, as well as illustrations of patterns cut on this machine.

TRADE NOTES

Hess Steel Corporation, Baltimore, Md., has established a branch office in the Kresge Building, Detroit, Mich. George B. Norcross, who is now representing the Hess Steel Corporation in that district, will be in charge.

Universal Equalizer Co., Cincinnati, Ohio, has removed from its old factory at 818 Broadway to new quarters at 132 Opera Place, where the company will have sufficient space to take care of its steadily increasing business.

Standard Electric Tool Co., Cincinnati, Ohio, is now occupying its new factory at York St. and Western Ave., where the company will have a modern plant which will make it possible to increase the present production from 50 to 75 per cent.

Van Norman Machine Tool Co., Waltham Ave., Springfield, Mass., has opened an office and demonstration room in Detroit. This new department of the Van Norman business is in charge of C. M. Tripp. The office is located on the ground floor at 74 Brush St., Detroit, Mich.

Advance Machine Co., 29th St. and Compton Ave., Los Angeles, Cal., manufacturer of cast-iron fittings and "Advance" pipe machines, has changed its name to Los Angeles Valve & Fittings Co., and all future business will be conducted under the new name.

Moltrup Steel Products Co., Beaver Falls, Pa., manufacturer of cold-drawn steel shafting and screw steel, finished machine keys, finished steel plates, and other steel specialties, has opened an eastern branch office in the Woolworth Building, New York City. The office is in charge of J. J. Callahan.

Bridgeford Machine Tool Works, and **Betts Machine Co.**, Rochester, N. Y., have established branch offices at New York City and Chicago. The New York office is located at 50 Church St., with F. C. Severin in charge, and the Chicago office at 549 Washington Blvd., with A. W. Van Buren in charge.

Morse Chain Co., Ithaca, N. Y., announces that the Kansas City offices of the western representative of the company—the Morse Engineering Co., St. Louis, Mo.—have been removed from the old quarters in the R. A. Long Bldg., to Suite 211-212, Finance Bldg. W. V. Warner is district manager in charge of the office.

Pangborn Corporation, Hagerstown, Md., has prepared a series of lantern slides, illustrating various types of sand-blast equipment, their application, and results obtained. The first of the series, which deals with sand blast as applied to general foundry work, will be exhibited at a meeting of the Newark Foundrymen's Association, April 2.

Walcott Lathe Co., of Jackson, Mich., has opened a large store at 254 E. Jefferson St., Detroit, Mich., where a stock of all sizes of Walcott lathes, Jackson shapers, and Jackson die-sinking machines will be carried. The Detroit store is under the management of L. E. Sliger who has been connected with the Walcott Lathe Co. for some time.

Aborn Steel Co., 26 Clarke St., New York City, has opened an office and warehouse in Boston, Mass. A complete stock of all high-grade steels will be carried in Boston for the convenience of the New England customers. This branch will be in charge of R. H. Smith as district manager. Mr. Smith was formerly with the Colonial Steel Co. and the Brown Wales Co.

Frank D. Chase, Inc., industrial engineers, have moved from the Peoples Gas Building, Chicago, Ill., and now occupy an entire building at 645 N. Michigan Ave., corner of Erie St. This change was made necessary by the continued growth of the business, and the company expects to be in a better position than ever to design, build, and equip industrial plants quickly and efficiently.

American Metal Products Co., Milwaukee, Wis., manufacturer of aluminum-bronze bearing metal and special acid-resisting bronze, has appointed the following district sales managers: J. S. Morrison, Oliver Bldg., Pittsburg, Pa.; Fred J. Michels, Cleveland, Ohio; G. B. Perlstein, Chicago, Ill.; Charles Kenyon, Penobscot Bldg., Detroit, Mich.; J. Kronman, 29 Broadway, New York City.

New Standard Hardware Works, Inc., Mount Joy, Pa., manufacturers of the New Standard unit system and process for the hot-tinning and retinning of all kinds of metals, have closed a contract for a No. 2 unit, which will be installed at the Sturges & Burns Mfg. Co.'s plant at Chicago, Ill. During the past two months plants were installed and completed at the works of the Buhl Stamping Co., Detroit, Mich., and the National Enameling & Stamping Co., Milwaukee, Wis.

Baldwin Engineering Sales Co., Room 915, Munsey Bldg., Baltimore, Md., has opened an office as manufacturer's agent for the Reliance Steel Casting Co. of Pittsburg, Pa., and the National Forge & Tool Co. of Erie, Pa. The territory covered by the company includes the states of Maryland, Delaware, the District of Columbia, Virginia, and Pennsylvania north to Philadelphia and west to Harrisburg. Quotations on the requirements of the trade in these districts are solicited.

Onondaga Steel Co., Syracuse, N. Y., announces, as a matter of general interest, that a shipment of high-speed steel scrap is on its way from Japan to Syracuse to be converted into high-speed steel by the company. This is the first shipment of high-speed steel scrap from abroad to be sent to the company, an exporting house at Tokio, Japan, having sent this consignment of scrap to this country as a trial order. When the steel goes back to Japan, it will be in the shape of bars of high-speed steel.

Wellman-Seaver-Morgan Co., Cleveland, Ohio, at the annual meeting of the board of directors, elected the following officers for the ensuing year: Edwin S. Church, president and general manager; S. H. Pitkin, vice-president; George W. Burrell, second vice-president; and W. H. Cowell, secretary and treasurer. Mr. Burrell, who has been in the continuous employ of the company for twenty-one years, will have entire charge of the company's works both at Cleveland and at Akron.

Onondaga Steel Co., Inc., Syracuse, N. Y., announces the following additions to its Board of Directors: Morton D. Whitford, treasurer of the Semet-Solvay Co., and a director of the Syracuse Trust Co., and Charles H. Canfield, general auditor of the Onondaga Steel Co. The company is planning to remove its offices and remaining furnace and melting equipment this spring from the original plant in Syracuse to its new plant at Eastwood, a short distance outside of Syracuse. Plans have been made for the construction of a large temporary office building and also for an addition to the main factory building, which will house a blacksmith shop and a small hammer shop.

International Oxygen Co., Newark, N. J., has opened offices in the First National Bank Bldg., Pittsburg, Pa., in charge of R. A. Cornwall. Philip Wesley, formerly Pittsburg representative of the company, has been placed in charge of the Chicago sales office in the Railway Exchange Building, Chicago. The British branch of the International Oxygen Co., known as the Integral Oxygen Co., Ltd., has begun the manufacture of I. O. C. electrolytic cells and other products for the British market. E. L. W. Byrne is the general manager in charge, with offices at 38 Victoria St., London, S. W., England.

Conradson Machine Tool Co., Green Bay, Wis., manufacturer of the Ryerson-Conradson line of machines, has awarded contracts for the construction of an erecting shop, 64 by 224 feet, and a machine shop, 128 by 192 feet, of sawtooth roof construction. All the machine tools installed will have individual motor drive. A power plant, 40 by 50 feet, fitted with direct-connected units, and a forging and heat-treating plant will also be constructed. The new factory will be used principally for the manufacture of lathes, turret lathes, and multiple-spindle automatic lathes, and will be ready for operation about July 1.

Hudson Motor Specialties Co., 1932 Arch St., Philadelphia, Pa., announces that the steadily increasing volume of business has made necessary a number of changes in its force. Raymond Hawley will continue as treasurer and executive manager, but his duties in connection with sales and advertising will be handled in the future by J. H. Malone, vice-president. Mr. Hawley will thus be able to devote a larger portion of his time to the upbuilding of the Precision & Thread Grinder Mfg. Co., and the Hudson Motor Axle Co. Ernest Georg has been appointed assistant secretary and assistant treasurer, and B. Reyes Noyola, cashier.

Hart Roller Bearing Co., 510 Main St., East Orange, N. J., has recently increased its capital stock to half a million dollars. A. C. Gaabeek is president of the concern. A. H. Williams, formerly works manager of the American Shell Co., Paterson, N. J., has recently been appointed works manager, and A. W. Kolbert, formerly of the American Shell Co., Paterson, N. J., takes up his duties as secretary and sales manager beginning April 1. A new factory of brick construction is being built for the future home of this concern at 50 Main St., Orange, N. J. The new factory has a total floor space of 20,250 square feet, exclusive of the forge shop, heat-treating plant and office. The new factory will be ready for occupancy about June 1.

Weekes-Hoffman Co., 122 Dickerson St., Syracuse, N. Y., has completed plans to enter the gear manufacturing industry, and expects soon to be turning out automobile and tractor gears and parts in quantity. Contracts have been signed for a substantial production of automobile gears that will take several months to execute. This company has been engaged in government work exclusively since last April, manufacturing shell-lifting plugs and adapters. The transition of the factory to the new line of manufacture is in progress and the machinery ordered will be installed as rapidly as possible. The expansion of the business will make necessary an increase in the capital stock from $200,000 to $500,000. The officers of the concern are John M. Weekes, president; W. H. Diefendorf, vice-president and general manager; and Adon J. Hoffman, secretary and treasurer.

Meachem Gear Corporation, Syracuse, N. Y., has been incorporated for the purpose of taking over from the New Process Gear Corporation the manufacture of rawhide pinions and the general manufacture of gears of various kinds. The company is incorporated for $300,000 and has purchased a three-story building at 411-415 Canal St., Syracuse, N. Y., which will be devoted entirely to the manufacture of gears. The officers of the new company are T. G. Meachem, president; T. W. Meachem, vice-president; and J. F. S. Meachem, treasurer, these being the same men who owned the New Process Gear Corporation and the New Process Rawhide Co. for a period of thirty years previous to its recent sale to John N. Willys. They have associated with them George W. Wood, who will be secretary of the new company and superintendent of the plant. H. W. Kiddle, who will be assistant superintendent, has had charge of the manufacture of rawhide pinions for many years with the New Process Gear Corporation. In addition to rawhide gears, the company will manufacture a full line of cut metal gears of all kinds.